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AVIATION
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AIRCRAFT JOURNAL

Vol. IX DECEMBER 13, 1920 No. 13

Secretary Daniels' Boomerang Argument

THE annual report of the Secretary of the Navy has been made to the President and a great amount of information regarding naval aviation is contained in the recommendations. Secretary Daniels recommends that the Navy operate all government vessels.

It is significant to note that the arguments that are used for the naval operation of transports, harbor boats, barges, lighters, the ships of the Shipping Board, Coast Guard, Public Health Service and all the other water craft of the various bureaus of the government are those to which the Navy has been opposed when used in favor of a united air force. To quote from the argument:

"America should have but one Navy. At present there are various 'little navies,' seagoing activities conducted under the supervision of different departments whose vessels could be far more advantageously operated under a single control. Economy and efficiency in government are the ends we are all seeking—the placing of governmental activities where they can be most effectively operated, preventing duplication of effort and material, eliminating lost motion, and insuring the best possible service at minimum expenditures. One of the main principles in operation is that all the forces engaged in the same kind of work should be concentrated under one head and in one organization."

No better logic has ever been penned for a united air force and it needs no further elaboration.

Piloting in a Race

DURING the last year there have been several examples of the difference between a speed record over a straight course and a speed race. The difference is caused by the necessity of turning corners and sometimes by making landings and take-offs. In these requirements the pilot is the deciding factor and a very good machine may be defeated by a poorer machine with a better pilot.

During the recent Pulitzer Trophy contest all of the winners made excellent turns at the pylons while some of the others lost time at each turn. Each of the first six entries drew favorable comment from the pilots who saw the race from the ground. These pilots were in order; Moseley, Hartney, Acosta, Street, Laverents, and Roullot. To these should be added Bradley in the Loening special. Both Laverents and Roullot were competing for class prizes in a field of standardized machines.

A large gain of controllability at the expense of two or three miles an hour of maximum speed sacrificed, would probably have a more favorable effect on the chances of the machine's winning a race than giving the machine a slightly increased speed at the expense of controllability. This is being recognized all over the world and foreign writers are prone to claim that the Gordon Bennett race was won because the French machines were better piloted. This is not so. The American pilots were as good as any they were pitted against. Manufacturers should consider carefully the conditions of a race in designing an entry and pilots should always bear in mind that the final decision depends largely on the way they fly the course.

Col. Clark Leaves Army

ONE of the greatest losses that the Army Air Service has sustained since the peace time organization has been effected is the retirement of its chief aeronautical engineer Col. V. E. Clark to engage in civilian airplane construction. It brings to the attention of the public, again, the fact that in a highly specialized branch where men of a high order of engineering judgment are needed, that the emoluments at present available are inadequate and unless substantial provision is made for such talent by legislation, the Army will always be at a disadvantage. The Navy has also an instance in the retirement of Commander Coburn who was in charge of the Naval Aircraft Factory and is now engaged in civilian work.

To lead the world in aeronautics as the United States will do if the plans now in formation are carried out, the best technical skill must be secured and to retain or attract such ability will be one of the most difficult problems that will come before the Air Service.

The many years that Colonel Clark has spent in specialization have given him an international reputation and placed him in the fore front of his profession. The Air Service loss will be the industry's gain, but the principle behind the change will, if allowed to continue disrupt the service and render McCook Field, the Air Service engineering center, barren of the high grade talent that it should have at its disposal.

Unguarded Secrecy

THE New York *World* printed the following sidelight on aviation during the Pulitzer Trophy Race:

"High officers of the Navy no longer make a secret of the fact that this country is planning a trans-Pacific flight. Two or three who were at Mitchel Field Thursday discussed the machine with which it will be undertaken, a nine-motor plane of 3,600 horsepower or more.

"The trans-Pacific plane is already taking shape at the navy establishment at Philadelphia, but it will be another year before it will be ready to hop off."

This is one of the subjects that is usually guarded with the utmost secrecy and it is interesting to know that it is a matter that newspaper men feel that they can write about with such certainty. Secretary Daniels in his report refers to this airplane but does not mention the purpose for which it is to be used.

Secretary Daniels on Aeronautics

The annual report of the Secretary of the Navy contains many references to aircraft and the policy of the Navy in regard to air work. In many respects the report is of the greatest importance to those who are aiding in the formation of an air policy for the government. Paragraphs giving various views of the Secretary follow without comment which can be reserved for at later time:

Excerpts from the Report

Naval aviation, which proved its effectiveness by extensive operations in Europe and America during the war, and in the flight of the NC-4 led the way across the Atlantic, has given fresh evidence of its efficiency in maneuvers with the fleet and in the most extended cruise ever made by seaplanes.

Starting from Philadelphia a squadron of six flying boats of the fleet air force made a seven-months' cruise to the West Indies and the Spanish Main, engaging in maneuvers with the fleet, and flying 12,731 miles under their own power without serious mishap or loss of life.

Big Twin-Enigne Planes Carry Heavy Load

Six large, twin-engine, biplane flying boats, known as Navy F-5-L's, weighing fully loaded, 6½ tons each, made up the squadron. With a wing spread of 103 feet, and a length from nose to tail of 50 feet, fitted with radio apparatus, anchors, mooring gear and emergency repair equipment, these big craft require two 400-horsepower Liberty motors for propulsion.

The normal crew of one of these air boats is two pilots, two enginemen, and one radio operator, but on this cruise they carried additional personnel, there being among the six boats between 50 and 60 men.

The "Shawmut" and "Sandpiper" Served as Tenders

The air squadron was accompanied on the voyage by the mine layer *Shawmut*, as a mother ship, and the mine sweeper *Sandpiper*, as a repair and fuel ship. Generally, the *Sandpiper* would precede the squadron from port to port, with the *Shawmut* bringing up the rear, on the lookout for planes which might have met with trouble. The function of both ships was that of a movable base, lacking, however, the general facilities of a permanent base. It was found, however, unnecessary to house the planes, and repairs of a kind which required hauling machines out of the water for any considerable period were few and far between, the aviators themselves making all minor repairs en route.

Anchored in Port Like Other Seagoing Craft

As each boat in the detachment carried its anchor and line, they were anchored out in the various ports of call in exactly the same manner as any other seagoing craft. In fact, they were often landed in the open sea in winds up to 35 or 40 knots an hour, and they rode with safety and without damage in gales exceeding 80 knots an hour.

At the very outset of their long voyage the planes met with severe tests of their airworthiness and seaworthiness, yet came through in a manner which demonstrated that air boats of this class are able to carry on continuous active operation over periods of time hitherto thought impossible.

Accidents Involving Repairs Were Readily Overcome

Accidents involving repairs that were easily overcome by the squadron personnel during the trip would have been thought a year before serious enough to put the planes out of commission. To the aviation mechanics these troubles were matters in the daily routine, to be taken care of just as are breakdowns constantly occurring on surface craft.

Carried Out Varied Exercises with the Fleet

For weeks at a time the squadrons engaged in general activities with the fleet at Guantanamo and adjacent waters, including communication exercises for the purpose of testing radio equipment installation and familiarizing the radio operators with the operation of the sets, making flights to furnish targets for antiaircraft sighting practice, making flights in connection with short-range battle practice, bomb dropping, night-flying practice, ferrying personnel and material for the operation of land machines, assembling airplanes and transporting them ashore, and in the overhaul and repair of airboats themselves.

The work of aircraft in connection with the battle practice of the fleet was of great aid in target practice and in assisting the directing of the fire of big caliber guns.

Performance of the Squadron Summarized

The performance of the squadron is given in the following summary:

Total number of flights, all machines, 495.

Average length of each flight, 2 hours 25 minutes.

Flights in passage, 8,210 nautical miles.

Other flights, incident to fleet operations, scouting, spotting for gunfire, etc., 4,521 nautical miles.

Total distance flown by the squadron as a whole, 12,731 nautical miles.

Total mileage of all machines, 71,545 nautical miles.

Total hours flown, 1,192 hours 25 minutes.

Deaths or serious injuries incident to flying operations, none.

"Considering the above figures," Lieut. Commander Leighton, who commanded the squadron, reported, "it is fair to state that while not yet fully solved the problems of long-distance practicable oceanic travel by air boat are well on the road to solution."

Successful Work with Fleets

In spite of postwar readjustment and reduction in personnel, naval aviation has carried on extensive air operations and exercises, 1,570,892 miles being covered during the year by Marine Corps and naval aircraft. But the real measure of the value of aviation for fleet purposes is not ability to fly for long distances, important as that is in overwater work, but the ability to coordinate the military efforts of aircraft with those of surface and subsurface vessels of various types. It is to this end that most attention has been and is being directed, and with decided success.

Aviation organizations have been created in the Atlantic and Pacific Fleets, which during exercises have utilized to advantage their aviation equipment and that made available from shore bases. Fleet aircraft have been successfully employed in the development of communications, position finding, fire control, and in the solution of various strategical and technical problems involving cooperation with surface vessels and submarines.

Division of NC Boats Formed

The NC-4, which made the first flight across the Atlantic, made a trip down the Atlantic and Gulf coasts and up the Mississippi River in the interests of recruiting, covering 5,822 miles with very satisfactory results.

A division consisting of these huge NC boats, with the *Harding* as tender, has been formed as a part of the Atlantic Fleet Air Detachment. The *Mugford* has been designated to act in the same capacity for the Pacific Fleet.

Bombing Planes Engaged in Experimental Work

A unit consisting of bombing planes has been organized and will operate in the Hampton Roads region, pending the commissioning of the *Langley*, for the study and development of the usefulness and employment of torpedoes and bombs as weapons for aircraft.

Developing Dependable Ship Planes

Development of ship planes, rugged yet handy, light but dependable; capable of flying from ships, of conveying personnel to observe, and to battle with the enemy, and to assist in controlling the fire of the ship's artillery, is proceeding. Though the operation of such machines is filled with complications, we confidently look forward to the day when aircraft will be transported by all classes of naval vessels.

Four battleships of the Atlantic Fleet are each equipped

with two flying-off platforms; each ship being supplied with two ship planes.

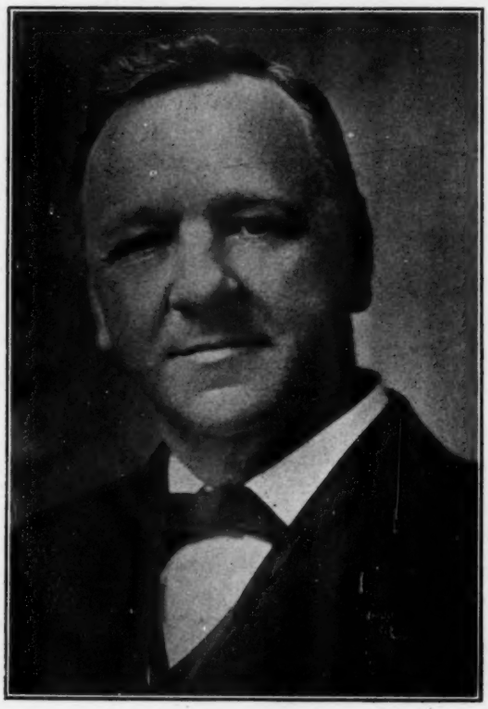
At Guantanamo the department has proceeded with preparation of a flying field for land planes, and is arranging for handling at this base the different types of aircraft operating with the fleet.

Aircraft Carriers—the "Langley" and the "Wright"

The former collier *Jupiter* is being converted into an aircraft carrier and will be ready for commissioning during the winter. This craft, renamed the *Langley*, will give the fleet an opportunity to develop the usefulness of vessels of this character.

The *Wright*, named for one of the brothers who demonstrated the practicability of aeronautics, formerly a B-type Shipping Board vessel, will, when commissioned, be assigned as a floating aviation base.

Aircraft carriers supply the primary means for permitting the operation of ship-plane units. These ships will permit the use of ship planes with the fleet in any quarter of the world, and are necessary adjuncts to our fleets. It is hoped that Congress will at the next session appropriate the funds necessary for the construction of ships of this class.



JOSEPHUS DANIELS

Largest Rigid Airship Nearly Completed

The Navy is making steady progress in the development of lighter-than-air craft. The R-38, the largest and most powerful airship yet built, will probably be finished in the spring, when it is proposed that it shall be flown to this country. Because of our lack of experience in the art of building and operating large lighter-than-air rigid units, it became necessary to go to Europe for our first great sea scout. The markets of Germany, the birthplace of the Zeppelin, were not open to us for this purpose, so it is being built in England by the same concern that constructed the R-34, which successfully made the voyage from Europe to America and return. Fourteen officers and 58 men are located at Howden, England, for instruction in rigid airships; and when the R-38 is completed we will have ready trained personnel for its operation.

Building Huge "Rigid" in America

The Navy has been charged with the development of rigid airships, and though larger appropriations are required to carry forward this work, all that is possible with the funds available is being accomplished.

Construction of a large rigid in this country has been undertaken and this enterprise marks the beginning of a new industry in America. At Lakehurst, N. J., the Navy is erecting the largest hangar in the world, and this is nearing completion. When finished it will accommodate two airships and will be used for the erection and housing of rigids.

At Cape May, N. J., another hangar for one ship is being erected. As soon as land can be procured on the west coast it is the intention to proceed with the construction of a large double hangar for rigids with the funds already appropriated for this purpose.

Using "Nonrigids" for Training Purposes

Its nonrigids are being utilized by the Navy for training purposes. Some 1,723 flights were made in lighter-than-air craft during the year, covering a total distance of 135,525 miles, without a serious casualty to personnel.

Exercises with kite balloons have been conducted in connection with ships with the view of determining their usefulness and the methods for their employment.

Value of Fish Patrols Demonstrated

Naval aviation has demonstrated a beneficial commercial use of aircraft. Early in the winter of 1919 the United States naval air station at San Diego, Calif., established an experimental fish patrol in conjunction with the fisheries of San Diego and vicinity. Seaplanes were used to patrol the large areas of coastal waters in search of schools of fish. These were readily located and the fishermen were enabled to make much greater hauls than would otherwise have been possible.

Experimental fish patrols were instituted at Hampton Roads during the summer of 1920 with the same excellent results.

The success of this patrol having been demonstrated, the Navy will discontinue this activity, leaving it to development by commercial enterprise.

Use in Mapping Inaccessible Regions

The Navy has demonstrated the usefulness of aviation for the survey of inaccessible regions. During the coming year it is planned to employ the aviation branch widely for this work in the areas where surveys are in progress.

Largest of Flying Boats Now Under Construction

The department has undertaken the construction at the naval aircraft factory of a giant flying boat larger than any now in existence. As planned, this will be a 60,000-pound vessel, with metal-wing structures, and a combination of nine Liberty motors in three groups. This is a development from the NC-4 type, the first airplane to cross the Atlantic, but the expansion to nearly three times the normal displacement of the NC-4 involves a number of difficult technical problems.

Airplane Cannon Developed—Six Guns Completed

Airplane cannon development has proceeded, and six guns are practically completed. After further tests and minor modifications to the firing mechanism and mount these guns will be issued to the service. It is contemplated using them as part of the armament of the NC type flying boat.

The armament of the small land-type airplanes used for duty on board ship comprises fixed machine guns synchronized to fire through the propeller.

Aviation Personnel—Number on Active and Inactive Duty

On June 30, 1920, the officer personnel on active aviation duty was as follows:

Regular Navy:	
Aviators	319
Student aviators	61
Ground officers	206
Naval Reserve Force (class 5):	
Aviators	201
Student aviators	18
Ground officers	37
Marine Corps	67
Total	909

The reserve officer personnel on inactive duty was as follows:

Naval aviators	2,017
Student naval aviators	227
United States Naval Reserve Force (class 5) (not aviators or student aviators)	952
Marine Corps	163
Total	3,359

Transfer of Reserve Officers Authorized

Owing to the acute shortage of regular aviators and regular officers for training as aviators, recent legislation passed provides for the transfer into the naval service of 500 tem-

porary and reserve officers who are or have been performing aviation duties. These officers are to be taken into the regular service when found qualified by examination.

In addition to the above reinforcement, recent legislation passed provides that the Secretary of the Navy may employ, with their consent, 500 reserve officers for the aviation and auxiliary services until July 1, 1922.

Enlisted Personnel of 7,000 Employed

The number of enlisted men employed in aviation duties on June 30, 1920, was—

Naval aviation ratings	4,404
General ratings (Navy)	1,740
Marine Corps ratings	856
Total	7,000

Only Necessary Air Stations Maintained

The Navy is maintaining only such air stations as are necessary from an operation standpoint. During the fiscal year several stations were demobilized, and on July 1, 1920, the number of stations in operation was 11, as follows: Rockaway, Long Island; Hampton Roads, Va.; Anacostia, D. C.; Parris Island, S. C.; Pensacola, Fla.; San Diego, Calif.; Quantico, Va.; Coco Solo, Canal Zone; Port au Prince, Haiti; Santo Domingo, Dominician Republic; Pearl Harbor, Hawaii.

More Stations Needed on Pacific Coast

Stations are especially needed on the Pacific coast, where at present but one exists, and in our insular possessions. It would be necessary in case of war to augment our aviation personnel by the addition of reserves and civilians, and every encouragement should be given to them. To this end the Government should proceed to create aviation facilities which will permit flying near our large centers of population.

Metal Airplane Construction

Up to the present time the structure of airplanes has been practically all wood. It has always been recognized that there would be great advantages in metal construction, but there are a number of very serious engineering problems in the way, requiring a great amount of research and experimentation for their solution.

We are not yet prepared to build planes of metal equally light and strong as those built of the best wood materials, but it may be said with confidence that we shall soon be building planes in an experimental way which will compare favorably with those built of wood, and with the rapid development of the art we may confidently predict that within a measurable time the metal construction will supplant the wood for at least the majority of naval planes.

Bureau of Aeronautics Should Be Established

No part of our Government more heartily favors restricting expenditures than does the Navy Department, but it is false economy to hamper the development of so important an activity as aviation by failing to provide an organization under which it can accomplish the best results.

In developing aviation as a naval activity we are confronted with the difficult problem of molding a new and important branch into an old organization not designed to care for it. The best interests of the Navy would be served by the creation of a Bureau of Aeronautics, appropriating money directly to the office of the Secretary for the purposes of aviation, and handling the appropriation as a single fund.

At present aviation funds for all purposes are allotted through the Office of the Chief of Naval Operations, who is directly responsible for details of aviation. This plan is defective in that it charges the Chief of Operations with numerous details with which he should not be troubled or concerned and places under his office administrative duties concerning aviation which do not properly belong there. These duties are handled under the Planning Section of Operations, a section not created or equipped for administrative purposes.

Legalized Bureau Needed to Coordinate this Work

A legalized bureau, with a definite organization that will permit coordination of the important work confronting aviation, would give to aviation the place which properly belongs to it in our naval household. Details involving other bureaus which are already equipped to handle such matters should not be assigned to Aviation, but the technical aviation sections of all bureaus should be detailed under the Bureau of Aviation to avoid delays and inadvertances now caused through the effort necessary to obtain concerted action.

Important to Develop New and More Powerful Types

That naval aviation will, in the not distant future possess an importance second only to that of our ships, is well recognized. Neither lack of necessary funds nor of an organization fitted to its needs should be allowed to hamper the development of this youngest and most promising branch of the service. The most important problems now are not those of production, as was the case during the war, but of developing new or improved types adapted to the needs; of developing strategy and tactics in the use of aircraft; of exercises with the fleets of which it is an integral part. We are still far behind certain other countries in lighter-than-air craft, and the construction upon which we are now engaged should be but the beginning in this important field. But types change so rapidly, the range of improvement is so large, that we should utilize our best naval experience and inventive genius in devising warships of the air as far superior to those of the present as are our latest battleships and battle cruisers to the surface vessels of a generation ago.

Establishment of Separate Air Service Would Be Unwise

Each service, Army, Navy, Post Office Department, has its own problems to solve. Airplanes suitable for one are often entirely unadapted to the purposes of the other. Land planes, by reason of their inability to sustain themselves afloat if compelled to alight on the water, are unsuitable for patrol over sea areas. Flying boats can not alight on land. Efficient service with an army requires military training. Efficient service with warships requires an intimate knowledge of naval operations, tactics and maneuvers.

No one more strongly favors the development of commercial aviation than I do, or is more alive to its importance. Yet to depend upon private concerns to develop the types of planes and airships adapted to military and naval purposes would be a fatal mistake. For these extended study and experimentation are required, work that can only be attempted and successfully carried on by the Government, and that branch of the Government which is considering its own peculiar needs. This entirely aside from the importance of keeping secret aviation developments and inventions that are of military value, upon which, in some future war, our effectiveness may largely depend.

For this and many other reasons I strongly oppose the placing of all aviation activities under one department or control. In common with the ablest naval authorities, I am convinced that the creation of a separate and independent Air Service would be unwise, and that such action would militate seriously against the development of naval aviation and its usefulness as an arm of the naval service.

Appropriation Should Keep Pace With Development

Every great nation is giving much attention to aviation and the development of new and larger types is commanding the interest of all who are concerned with the conquest of the air. The possibilities of aircraft are limitless, and the use of battle planes in war may revolutionize warfare. The United States ought to lead in study, experiment, development, and construction. Appropriations should be ample for this modern agency of transportation and war.

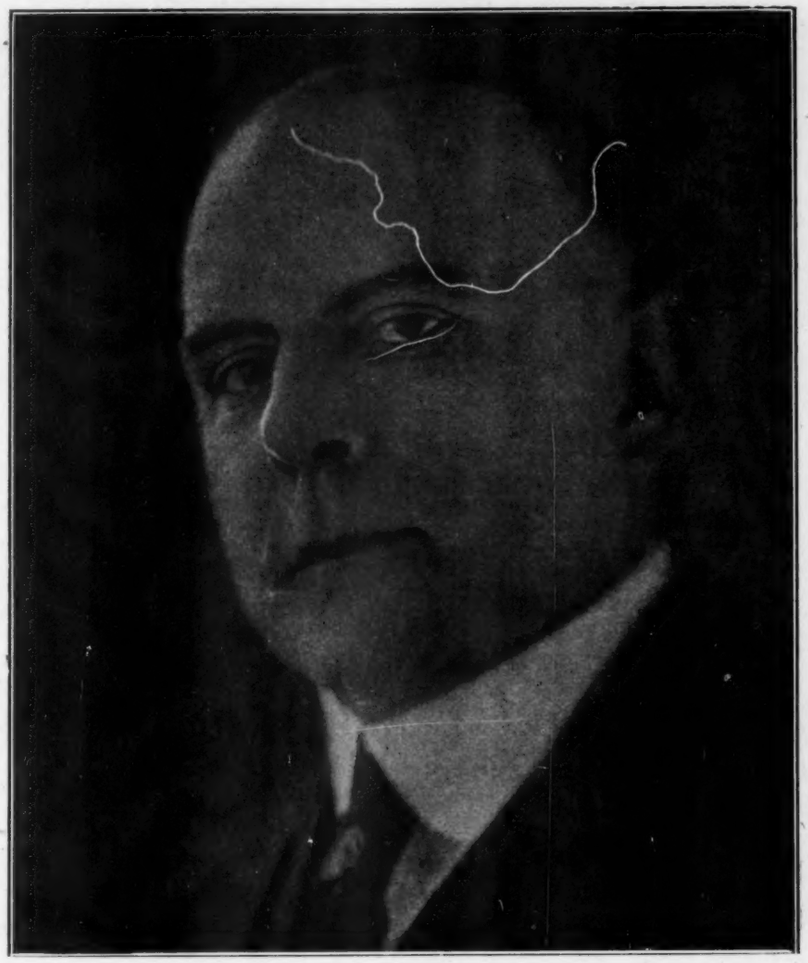
Airplanes Sold Realized $639,687

The sale of airplanes has proceeded steadily, a total of 103 new machines having been sold for $608,591, and 52 used machines for $30,096, making the total proceeds from this source during the fiscal year $639,687.

Postmaster General Burleson on the Air Mail

In the annual report of the work of the Postoffice Department, Postmaster General Burleson gives the following interesting summary of the work of the Air Mail Service:

The Air Mail Service operated during the fiscal year with increased efficiency, increased saving in car space, and greater expedition of the mail through the extension of the service to additional commercial centers. There were three extensions of the service—one from New York to Cleveland—as discussed in the previous annual report. Through this extension the service was completed from New York to Chicago.



OTTO PRAEGER, SECOND ASSISTANT POSTMASTER GENERAL

The second extension was from Chicago to Omaha, which service was inaugurated on May 15, 1920. The distance of this route is 440 miles air line. The planes leave Chicago with Chicago and eastern mail for Omaha, at which point they arrive in time for afternoon delivery. Had this mail gone by train, it would not have reached Omaha in time to effect its delivery to the postal patrons before the following morning. Eastbound, the mail leaves Omaha about noon and reaches Chicago that afternoon in time to catch all connections out of Chicago 12 hours earlier than if it had gone by train. The commercial interests of Omaha have cooperated splendidly with the Air Mail Service by furnishing a large air mail field and perhaps the largest civilian hangar in the United States.

The third extension was the opening of the route between Chicago and St. Louis on August 16, 1920. The dispatch is such that the mail from Chicago arrives in St. Louis in time for the first afternoon delivery instead of the delivery on the following morning; and northbound, the St. Louis mail arrives in time for delivery in Chicago that afternoon instead of the following morning. The city and the citizens of St. Louis have created at Forest Park a large public aerodrome, the hangar on which is for the exclusive use of the mail service.

During this fiscal year extensive preparations were made for the inauguration of the New York-San Francisco transcontinental air mail route by the extension of the route from Omaha to San Francisco. The citizens of North Platte, Nebr., Cheyenne and Rock Springs, Wyo., Salt Lake City, Utah, Elko and Reno, Nev., and San Francisco, Calif., have laid out large public landing fields and have erected thereon, for the exclusive use of the air mail, extensive hangars. The service was inaugurated on September 8, 1920, and the initial westbound trip was made at the rate of 79.9 miles per hour and was effected without a forced landing either for weather or mechanical trouble. The plane carried 16,000 letters, which arrived in San Francsco 22 hours ahead of the best possible time by train had the train made all its connections.

In the operation of the New York-San Francisco service the Post Office Department had to choose between advancing 16,000 letters 42 hours, each direction, or by combining the air mail with the railway service, using trains at night to advance 64,000 letters 24 hours, each direction. It decided upon the latter policy, which is accomplished by the following operation.

The plane leaves New York at daybreak with 16,000 letters that would not depart from New York for San Francisco until 8.40 o'clock that night and delivers them in Chicago that afternoon in ample time to dispatch them to the through west mail connection which left New York at 8.40 the previous night. These 16,000 letters are thus advanced 24 hours.

At Chicago, by use of larger planes, 32,000 letters taken from a New York train arriving at Chicago during the night are dispatched from Chicago at daybreak to Cheyenne, Wyo., where they arrive in the afternoon in ample time to place them on the through San Francisco mail connection, which has left New York two nights previous. Thus these letters are advanced more than 24 hours.

At Cheyenne 16,000 letters are taken from the through west mail connection which arrives in Cheyenne during the night. These 16,000 letters are started for San Francisco at daybreak and delivered that afternoon in San Francisco by plane, making at least a day's advance in this quantity of mail. Thus 64,000 letters have been advanced 24 hours in their transit from New York to San Francisco.

The eastbound movement, utilizing trains moving at night, similarly expedites the same quantity of mail to New York City.

Regular night flying with the mail has not been practical with the present types of planes in the mountain sections, but it is practical in the level country of the Middle West, and the department is making preparations in the way of lighting regular and emergency landing fields and equipping planes with magnesium flares. This service will be inaugurated in the early spring between Chicago and Cheyenne, Wyo., and will result in delivering mail from New York to

Cheyenne within 24 hours. The run from Cheyenne to San Francisco will then be a matter of 12 hours' flying.

The Navy Department has agreed to deliver to the Post Office Department 15 Caproni planes, mounted with three engines, capable of carrying a ton and a quarter of mail. The planes with the multiple power plants are intended to be used on the night flights.

Incidentally, in addition to this very great expedition of the mail between New York and San Francisco, the transcontinental air mail will prove of great value to the military air operations through the maintenance every 200 miles of hangars, landing fields, and mechanical and fuel facilities, which are always at the disposal of the military forces.

The fourth extension of the air mail from Chicago to St. Paul and Minneapolis, as an adjunct to the Railway Mail Service, and a feeder to the mail trains and the transcontinental route, at Chicago, is being put into operation.

The New York-Washington route has operated during the fiscal year successfully and dependably. On account of the speed of the planes, the air mail has been able to make better connections with the carrier delivery in Washington than was the train service which it superseded.

A notable feature of the Air Mail Service was its operation during the winter of 1919-20. That winter, from the standpoint of temperature, snow, and ice, was the worst one experienced in a number of years, yet the air mail between New York and Washington during the month of February made successfully 36 trips out of a possible 46 trips scheduled. In the Lake region there was a great deal of snow as well as storms, and from Cleveland to Chicago there were 41 successful trips out of 48 scheduled to be flown during February, 1920. The operations during that winter developed much information of value to aviation, which should result in further improved operations during the coming winter.

The American Air Mail Service today consists of three routes, aggregating a total of 3,094 miles, over which one round trip daily except Sunday is flown. The total flying of the mail planes, including ferrying and testing of planes, aggregates 1,893,528 miles. The total personnel engaged in this far-reaching operation is divided as follows:

Supervisory official and clerks in Washington	19
Field forces:	
Superintendents	7
Field clerks, etc	37
Pilots	52
Mchanics and helpers	162
Watchmen, laborers, etc	72

This personnel is at the rate of one employee for each 5,988 miles per year flown.

The following are the landing fields that are being maintained for the operation of the air mail. They are about 200 miles apart and form the greatest unbroken system of equipped and manned aviation terminals in the world.

Location.	Hangars.	Employees.	Remarks.
College Park, Md.....	3	30	7 miles of Washington, on New York-Washington route.
Bustleton, Pa.....	2	40	14 miles of Philadelphia; eastern repair shop.
Newark, N. J.....	1	27	Heller field: New York-Washington route.
Do.	..	23	General air mail warehouse.
Mineola, N. Y.....	3	26	Under temporary lease for New York-San Francisco route.
Bellefonte, Pa.....	1	11	Under course of erection for New York-San Francisco.
Clarion, Pa.....	1	..	Emergency reserve field; New York-San Francisco route.
Cleveland, Ohio.....	1	35	Glenn Martin field for New York-San Francisco route.
Bryan, Ohio.....	1	3	Emergency reserve field for New York-San Francisco route.
Chicago, Ill.	3	52	New York-San Francisco and Twin Cities-St. Louis route and western repair shop.
Iowa City, Iowa.....	1	6	Temporary facilities and reserve landing field.
Omaha, Nebr.....	1	17	Ak-Sar Ben field on New York-San Francisco route.
North Platte, Nebr....	1	4	Under construction for New York-San Francisco route.
Cheyenne, Wyo.....	1	12	On New York-San Francisco route.
Rock Springs, Wyo....	1	4	Under construction: New York-San Francisco route.
Salt Lake City, Utah..	1	20	Do.
Elko, Nev.....	1	6	Do.
Reno, Nev.....	1	18	Do.
San Francisco, Calif...	1	31	Do.
Minneapolis-St. Paul...	1	9	Twin Cities-St. Louis route.
St. Louis, Mo.....	1	15	Do.

The cost of operating the Air Mail Service, including interest on investment, the writing off of losses for planes and equipment damaged beyond repair, and including every conceivable expenditure in connection with the flying of the planes, was $553,156.10.

For this expenditure the air mail advanced the delivery of 23,463,120 letters 16 to 24 hours and at a less expenditure than it would have cost to transport and distribute them on the trains.

The expenditure for adaptation of surplus military planes to air mail work and the purchase under bids of needed modern equipment, besides the improvement of landing fields and the equipment of hangars which have been donated by various cities, aggregated $646,143.70.

All flying operations over any length of time are attended by accidents and casualities, but the air mail has been fortunate in a relatively low casualty list. Mail operation is essentially a cross-country work, where the pilot, in the event of accident, must land on any spot available. This increases the hazard of damage to plane in landing, as well as the danger to the pilot, yet in the work of the Air Mail Service from its inauguration on May 15, 1918, to date, covering practically 1,000,000 miles of flying over all character of country and in every condition of weather, the air mail has lost but eight pilots killed in carrying the mails. In addition, two pilots who were attempting to qualify for positions as mail fliers, and one pilot riding as a passenger who either fell or jumped from a plane, lost their lives. Three mechanics were killed in airplane accidents and two lost their lives on the ground at air mail fields. In most of the accidents resulting in casualties a knowledge was gained which led to the improvement of the factors of safety in flying the planes.

In two years and three months' operation of the service, covering a mileage of 993,904, the total cost of planes rendered unrepairable by accidents of all character aggregates $347,844, or 35 cents per mile. This was principally surplus war material put to civic use by the Post Office Department, and the value of the damaged war planes is not their value in the open market after the armistice, but the full value of the planes to the Government as built during the war.

There are still on hand in this country thousands of planes, obsolete for military purposes but which can be adapted to the carrying of the mails and which will be ultimately rendered useless through deterioration in storage if not put into service by the Post Office Department. Aside from the progress made in developing military planes, the tendency in aviation has been toward the creation of types that will carry greater loads at less expense and with longer cruising radius, so as to eliminate intermediate stops for gasing. The greatest advance in this direction was made in Germany, and when a small number of German planes were introduced in this country the Post Office Department, together with other governmental activities purchased some of these planes for thorough testing in daily operation. The planes are all metal, built of a light aluminum alloy, which carry 1,000 pounds commercial load with 240-horsepower motor and have a cruising radius of six to seven hours in low-grade fuel, as against the salvaged war planes in the Mail Service which carry 400 pounds of mail with 400-horsepower engine and have a cruising radius of three hours with high-test gasoline.

They offer a solution for commercial work by reducing the cost of operation probably 50 per cent. Their introduction into this country has turned the attention of American manufacturers to the building of planes of greater economy of operation and their tests by the air mail have furnished information that will enable the Post Office Department to utilize some additional discarded war-training planes. These salvaged war planes that are now being prepared for the mail service will carry 600 pounds of mail with 240-horsepower motor and have a cruising radius of five hours. The utilization of these planes will cut the operating cost about 40 per cent.

In addition to the direct operation of the transcontinental air mail route and its feeder lines, the Post Office Department under the law has let a contract for carrying the mail by seaplane between Key West and Havana and by land plane on the following three routes:

(*a*) Between New York and Atlanta, via Washington, Raleigh and Columbia, a distance of 815 miles.

(*b*) Between Pittsburgh and St. Louis, via Columbus, Cincinnati, and Indianapolis, a distance of 600 miles.

(*c*) Between New York and Chicago, via Harrisburg, Pittsburgh, and Fort Wayne, a distance of 735 miles.

The mail in each of these cases will be expedited by from 12 to 16 hours, and the contracts for the land routes on advertisements for bids were let at prices within the amounts that will be saved on transportation of these mails by railways. A contract has been let from October 15, 1920, to June 30, 1921, for a route from Seattle to Victoria, British Columbia, to connect with the steamer which left Vancouver on the day previous, and thus dispatch between 12,000 and 14,000 letters to the Orient with a saving of time equal to the elapsed time before the departure of another steamer.

The Postmaster General has from time to time urgently recommended to Congress a fuller development of the Air Mail Service. The plan of the department has been not only to establish this expeditious service between the principal commercial centers but to connect them with the gateways on our seacoasts and on our northern and southern boundaries in order to expedite mail to foreign countries. Notwithstanding that the business interests of the various large communities were keenly alive to the importance of this expeditious mail movement and were willing to contribute heavily to the establishing of air mail fields and hangars, Congress failed to respond to these recommendation in a manner that would have enabled the department to better meet the needs and demands of the important cities. Not only have the business interests of the country urged and supported the proposed comprehensive air mail, but the military authorities have given it enthusiastic support as a peace-time nucleus which the country would need seriously in the event of war.

In a study of the question of encouraging civil aviation the general staff of the Army points out the economy of developing commercial aviation in time of peace as a foundation for sudden and large expansion in time of war, and sets forth the impracticability of making immense appropriations for military aviation in times of peace in order to enable the military service to speedily cope with a war situation.

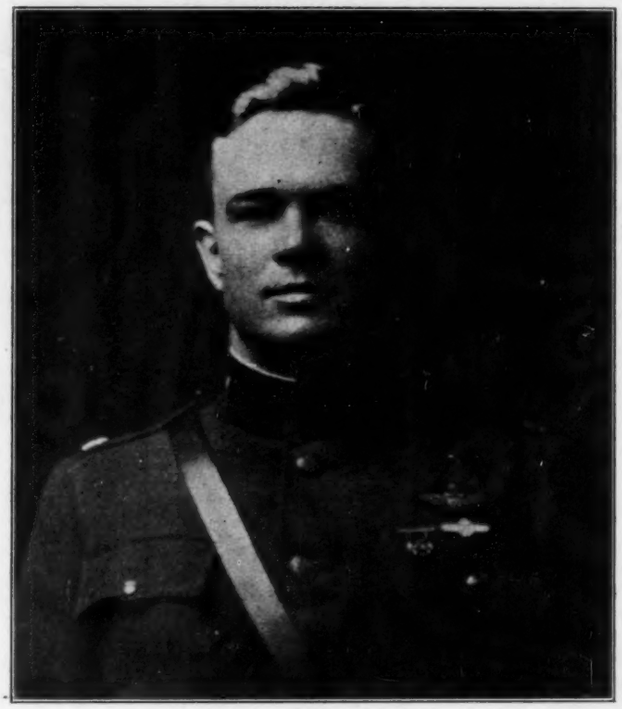
The post office department has endeavored to point the way to practical commercial operation of airplanes in its operation of the air mail, and it has brought the work to the point where it will be possible to make contracts with commercial enterprises for carrying the mail in connection with passenger and other traffic. It recommended legislation that would permit the department to make such contracts, but Congress responded to this in an insufficient manner by the adoption of a provision in the law which requires that contracts for mail by airplane shall not result in a greater cost for transportation of the mail than by trains. This restriction takes no account of the greater expedition of the mail by plane service over train service. The post office department has investigated the possibility of contract air mail service between a number of cities, which service would expedite the mail over existing train schedules, but not at a less cost than by train.

One of these investigated covered a proposed route between St. Louis and Kansas City, which would connect the latter city with the air mail system at St. Louis. Although it would mean a great saving in time, it was not found possible to let this contract because the cost of this transportation would be greater than by train. The same situation was found on investigation of the mail service between New York and Norfolk. Letters mailed in New York City which can not be distributed in time to catch the southbound train leaving New York about 8 p. m. can not be delivered in Norfolk until the second day owing to schedules of train operations. By taking this mail from the train at Baltimore and carrying it by seaplane over Chesapeake Bay the letters could be delivered in Norfolk on the morning following their mailing in New York. However, no saving in transportation by train could be made by such an airplane contract, and the law not taking into consideration the expedition of the mail, the department could not provide this greatly improved service between the two cities.

These are only a few of the important mail possibilities investigated by the department. The law should be amended so as to permit the making of contracts for carrying mail by airplane, even at increased cost over train service, considering the commercial benefits to be derived from the greater expedition of mail. In addition to amending the law so as to permit of a more liberal contract service I urgently recommend that the system of government routes be extended as follows: Boston to Detroit, via Buffalo; Chicago to Los Angeles, via Kansas City; St. Paul-Minneapolis to Seattle; and St. Louis to New Orleans, via Memphis.

Col. Clark Joins Dayton Wright

Col. Virginius E. Clark who has been the chief aeronautical engineer of the Army Air Service since July 1, 1915, has left the Army and is to become the Chief Engineer of the Dayton Wright Division of the General Motors Corp. Col. Clark



Col. V. E. Clark Who Has Retired as Chief Aeronautical Engineer of the Army to Become Chief Engineer of the Dayton Wright Division of the General Motors Corp.

is one of the pioneer aviators of the Army Air Service having been one of the original 1913 San Diego school of fliers.

A graduate of Annapolis, Clark left the Naval service for aeronauties and was sent to the Massachusetts Institute of Technology for a course in aeronautical engineering. He has been a Military Aviator since 1917. During the war, Col. Clark was engaged in the engineering supervision of the design and construction of our military airplanes and went to Europe as a member of the Bolling Mission. Colonel Clark was in charge of the organization and construction of McCook Field and was its first commanding officer.

Since the war he has been stationed at McCook Field where he has been in charge of the design and planning section of the Engineering Section of the Air Service. He has been a member of the National Advisory Committee for Aeronautics, Joint Army and Navy Technical Board for Aeronautics and the Aeronautical Committee of the Society of Automotive Engineers.

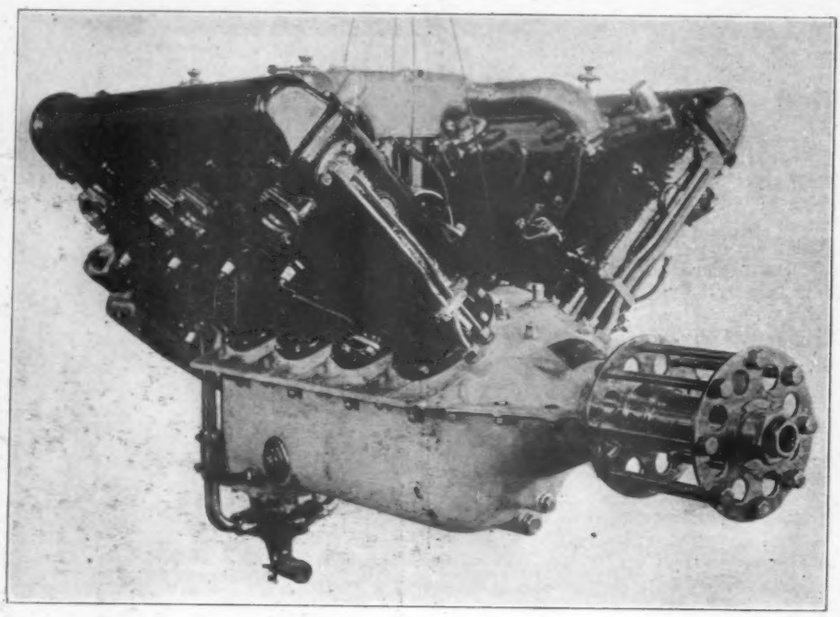
Promotions in the Air Service

The following list of promotions to the grade of major was announced by the War Department on November 24. Captains promoted to Major, as of July 1, 1920. W. A. Robertson, J. H. Jouett, H. Abbey, Jr., M. Kirby, T. G. Lanphier, B. G. Weir, S. H. Wheeler, R. Royce, C. Spatz, J. T. McNarney, H. B. S. Burwell and C. W. Howard.

New Wright Aeronautical Engine

The recent announcement of the Wright Aeronautical Corp. that it had so changed and improved the engine which it has been manufacturing as the Wright-Hispano that it had changed the name to Wright, is of deep interest in the aeronautical world.

First the engineers of the Wright-Martin Co., parent organization of the present Wright company, brought back from France with them the plans of the Hispano-Suiza and the right to manufacture it in America. Then one change after another was made in the engine design until the whole had been so reconstructed that the American builders with the consent and approval of the Army Air Service placed their own name upon the product and it was known as Wright-Hispano. Further improvements have so changed the engine that the Wright company believes that it is entirely American now, and, in the words of F. B. Rentschler, vice-president of the company, "no more a Hispano-Suiza engine than the Liberty is a German Mercedes."



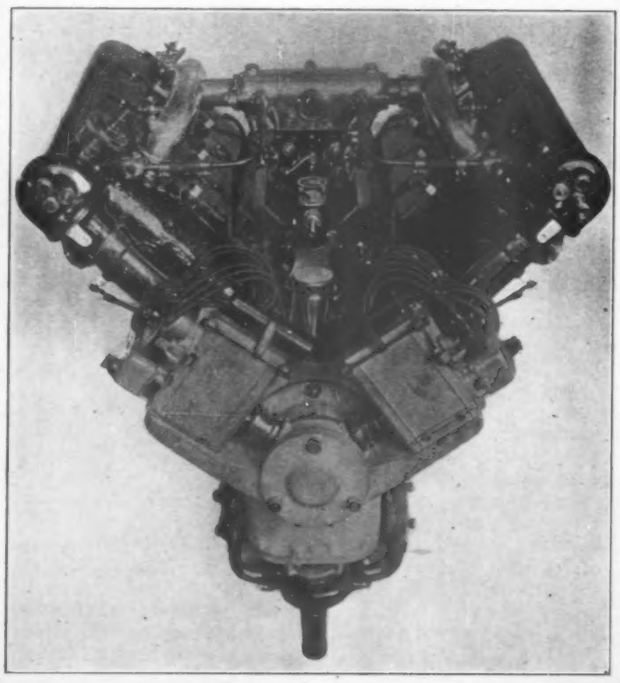
FRONT END OF WRIGHT ENGINE SHOWING OIL OVERFLOW PIPES AND SMALL DEPTH OF CRANKCASE

"Nothing in this world can remain stationary" Mr. Rentschler said "It either goes forward or backward. This is especially true in everything pertaining to aeronautics. An aeronautical engine must change constantly; must be improved to meet the changing demands placed upon it by the plane designers and by the needs of the Army and Navy Air Services. Our engineers have so improved the Hispano-Suiza that we consider we are justified in changing the name to that of the fathers of flying, the Wright brothers."

The great success of Allied aces in "Hisso" motored combat machines against the best that Germany would produce in the engine line is well known. The Spad was long supreme as a one-seater on the western front. But several years have passed since that time, and a year measured in terms of aeronautical improvement is a long time. The Wright Aeronautical Corp. picked the Hispano as the best engine in the world after its experts had studied various types for more than a year. Their engineers, however, were not satisfied merely to turn out Hispanos even after the American rights, had been purchased and the Air Service clamored for huge production. The first 2,500 made at the big New Brunswick plant were only slightly modified, but these modifications were so successful that a number of changes in design were made with the consent of the Air Service.

The Hispano as it came to America was delicate, sensitive and high spirited. The big defect lay in the relatively low durability. It was therefore toward greater sturdiness and reliability that the Wright engineers worked, although they preserved the lightness and great flexibility of the original motor.

"By means of the change the Wright Corp. made in cylinder construction over the original Hispano, this engine is capable of a life between overhauls as long, if not longer than that of any other aeronautical motor." Mr. Rentschler continued, "The Corporation was well aware of the criticism against the Hispano to the effect that the valves were delicate and set about the solution if this problem. To illustrate the results obtained by the change in cylinder construction, one Wright engine has been running at McCook Field, Dayton, in ordinary flight for more than 150 hours without overhaul, and at the last report was still running, causing no trouble. The valves on this engine have never been ground nor has any other repair work been done."



REAR END OF WRIGHT ENGINE SHOWING NEW INCLINED MAGNETO MOUNTING

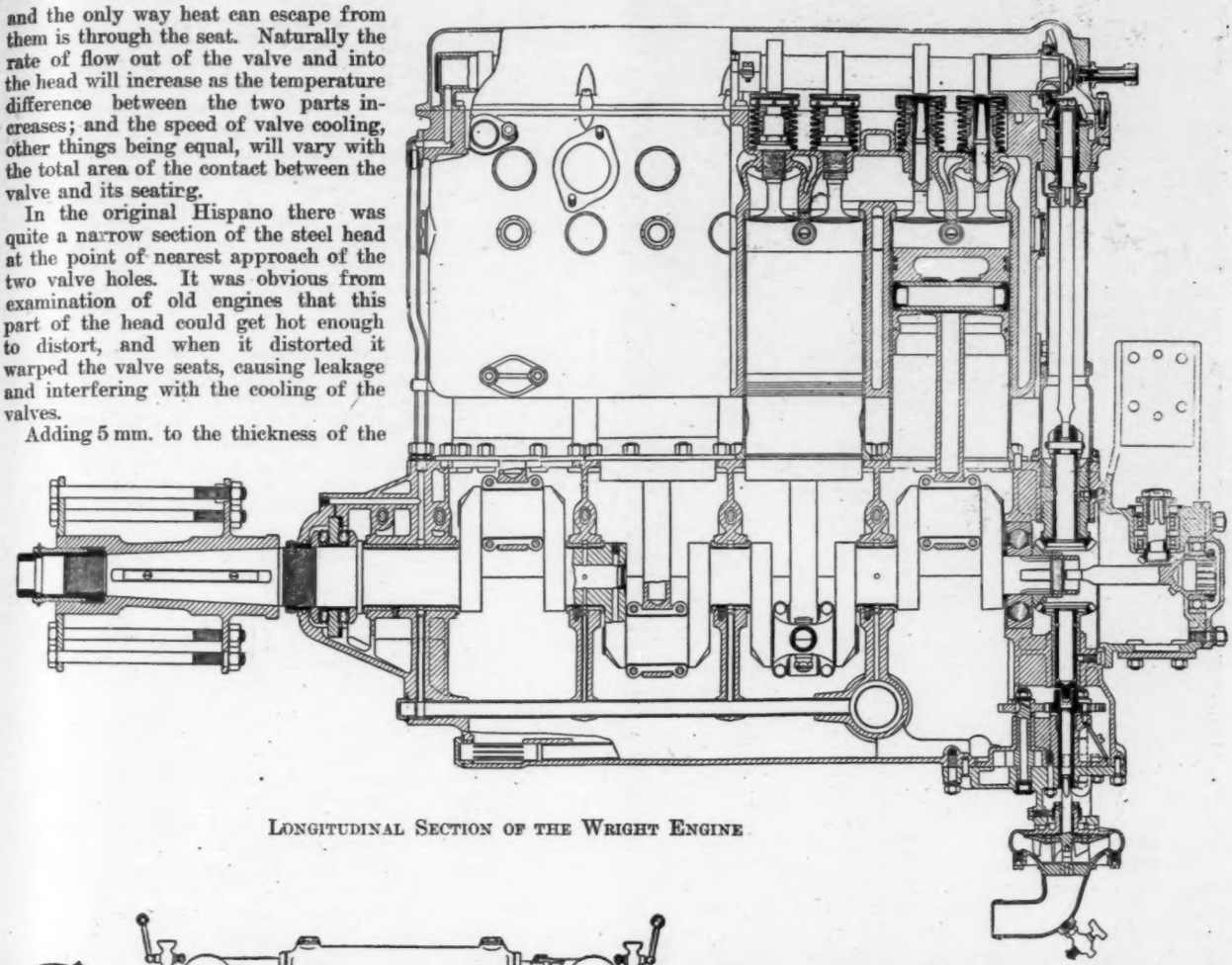
More than fifteen major mechanical changes and improvements have been made in the "Hisso" by the Wright engineers.

The early French engine had very thin heads in the cylinder sleeves and considerable trouble was experienced with the valves. At first the Wright engineers thought the trouble was due to valve warpage, but careful study revealed that it was due to cylinder warpage. The better cooling obtained from the thick head is analogous to the good results resulting from the use of a thick piston head. Valves, especially exhaust valves, are the hottest parts in any engine

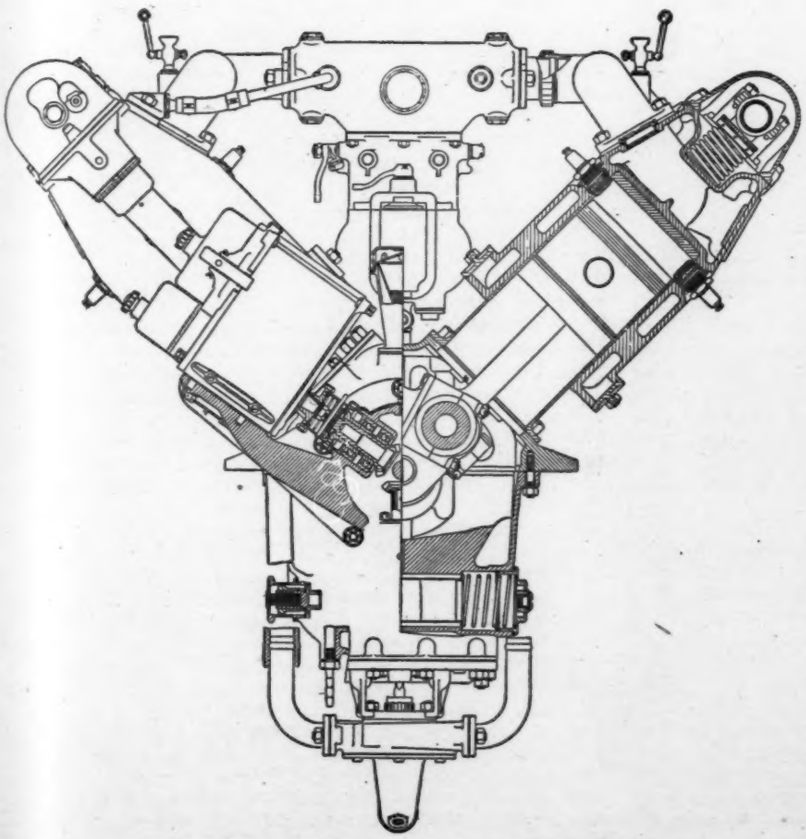
and the only way heat can escape from them is through the seat. Naturally the rate of flow out of the valve and into the head will increase as the temperature difference between the two parts increases; and the speed of valve cooling, other things being equal, will vary with the total area of the contact between the valve and its seating.

In the original Hispano there was quite a narrow section of the steel head at the point of nearest approach of the two valve holes. It was obvious from examination of old engines that this part of the head could get hot enough to distort, and when it distorted it warped the valve seats, causing leakage and interfering with the cooling of the valves.

Adding 5 mm. to the thickness of the steel sleeve head has increased the cross sectional area of the middle part to a point where it can conduct away the heat given to it, even under the most severe conditions without expanding at a greater rate than the remainder of the head. Consequently the valve seats stay true and the valves cool.



LONGITUDINAL SECTION OF THE WRIGHT ENGINE

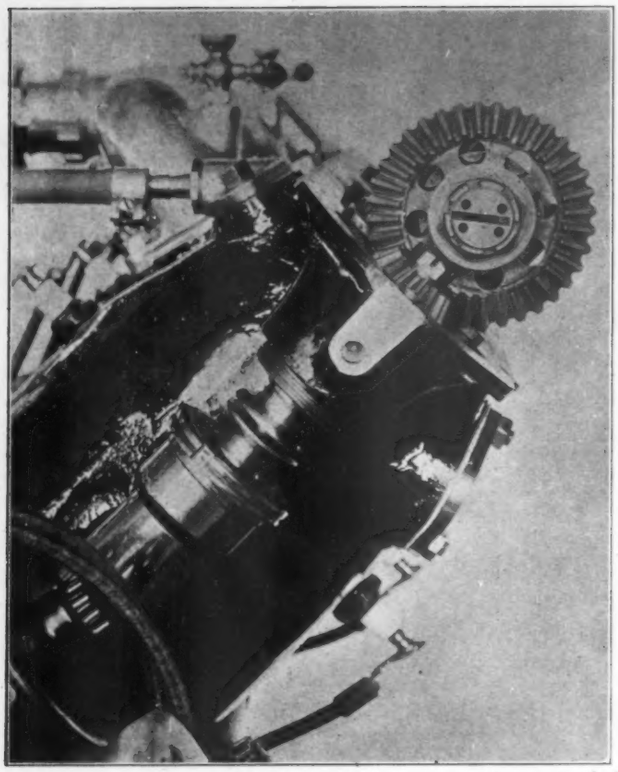


TRANSVERSE SECTION OF THE WRIGHT ENGINE

The valves themselves were also somewhat changed in design. The size of the neck was increased to allow a better heat flow away from the face of the valve, thus keeping it cooler and making it less likely to burn. The design of the cylinder block was changed to allow increased circulation of cooling water around the exhaust valve seats.

The installation of American magnetos and an American ignition system was one of the first changes made, but in the new model the magneto mounting has been also improved. As will be seen in the illustrations the two magnetos are inclined with their breaker ends raised up so that the same openings in the capotage which give access to the spark plugs also lay bare the distributors.

Then again, in the older design the magnetos were driven by a single transverse shaft with a coupling on either end; which meant that one magneto ran right hand and the other left, and therefore necessitated a double stock of spares. In the new layout the magnetos are driven by two, separate bevel pinions meshing with one master bevel, and thus they rotate in the same direction.

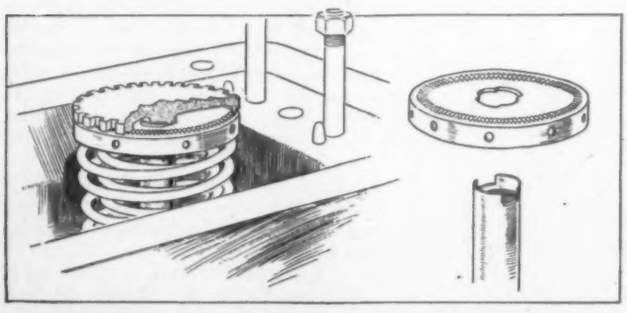


NEW TIMING ADJUSTMENT OF WRIGHT ENGINE SHOWN DISCONNECTED

Yet another advantage of tilting the magnetos is that it raises the outer ends of the bracket, which permits the bed timbers to be run right back along the fuselage, should the plane designer wish to do this.

The design of the pistons was altered completely. The piston pin was changed from the fixed to a floating type. The modified piston does not burn so easily and is a better manufacturing job. The original Hispanos had a set screw which held the piston pin in place. This in service, due chiefly to the carelessness of mechanics, was sometimes likely to drop out, often going through the head of the piston or through the bottom of the crank case. This permitted the piston pin to rub against the cylinder wall, scoring it and spoiling the motor until expensive repairs could be made. The floating type of piston pin, it has been found, gives better wear than the fixed type.

The first type of floating pin used was held against endwise movement by aluminum caps locked into the piston by tongues, as in the Liberty engine pistons, but this has been simplified for the new engine. Here a small, rounded bronze button is forced into each end of the hollow pin, fully protecting the walls of the cylinders against scratching.



ON THE WRIGHT ENGINE THE TAPPET ADJUSTMENT IS OBTAINED BY THE SERRATED VALVE SPRING WASHER

Another change is the provision of four separate ring grooves instead of placing a pair of rings in each of two grooves. This keeps the rings cooler, decreases the wear on the sides of the grooves and makes a tighter job altogether.

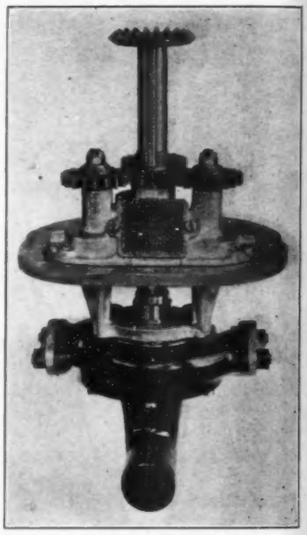
Changes were also made in the connecting rod and bearing. The French inner connecting rod and bearing were integral with each other. This made the lightest possible construction, but defects were that the manufacture of these bearings were exceedingly difficult and their life in actual service very short even under the best of conditions. The change to the Wright type gave a great increase in duration of this member, and also made a simpler manufacturing operation.

A new carburator for the Hisso was also developed. The new carburator has many merits, but the most important is the more complete control of the mixture. This is especially useful in altitude work.

The French design of the lower half of the crankcase was for a wet sump motor, that is, one carrying its own oil in the lower half of the crankcase. On steep dives or steep climbs this meant there was danger that the cylinders in front or in the rear would be flooded. The first American modification was to use an auxiliary oil pump placed on the rear of the magneto bracket to make the moter a dry sump job. This was found to be only a makeshift. A later design placed all oil pumps together in a compact unit, easily accessible and properly placed.

From the sectional drawings it will be seen that there is a main pressure line inside the crankcase, also a suction line from the front end thereof.

The pump assembly comprises three separate pumps, one the pressure pump, one the suction pump drawing from the front end of the case and the third sucking from the rear end. Either of the suction pumps alone can discharge oil from the crankcase faster than the pressure pump can take it from the tank, therefore the crankcase is certain to be always dry. A neat detail is that the base plate of the pump contains corded passages with ports which register with the ends of the internal oil lines, so that these connections are made automatically when the pump is put in place. Quite a small opening in the housing beneath the engine suffices to permit the easy removal of the oil strainer or of the complete pump assembly.



OIL AND WATER PUMP ASSEMBLY OF THE WRIGHT ENGINE

An oil lead from the front end of the camshaft housing is run back down to the crankcase to take care of overflow oil when the plane is diving, as well as to prevent the camshaft housing from inundation and possible leakage down the valve stems.

A slight change was also made in the upper half of the crankcase in order to give oil a direct lead to the front thrust bearing. This improvement permits unobstructed lubrication of the bearing, which is very heavily worked and is also a precaution against possible trouble from partial failure of splash lubrication. The rear end of the crankcase was slightly changed to accomodate the magneto bracket, which is interchangeable on the 180 and 300 horsepower engines.

One change which will be very much appreciated in maintenance shops is the addition of a device which makes timing easy. In the Hispano engine timing was a somewhat complicated process, involving changing the mesh of several pairs of bevel gears and the moving of the camshaft gear on its key. In the new engine the bevel pinion at the upper end of the vertical camshaft drive shaft is no longer integral with the shaft itself, but is locked to it by a serrated jaw coupling with very fine teeth. By slacking off the nut at the extreme top of the vertical shaft the coupling is broken and the cam-

shaft can be turned freely. The teeth of the coupling are fine enough to enable an adjustment of as little as one and a half degrees to be made, measured in camshaft rotation, which is even finer than was possible by the laborious process used in the old engine.

The design of the water-pump attachment and outlet is slightly modified to make them more compact and accessible. A fuel-pump for handling gasoline without the use of a pressure-tank and air-pump has been provided on the bottom of the new magneto bracket, and provision has been made for the installation on the magneto end of the engine of a standard type electric starter.

But although the "Americanized" engine is, in the opinion of many aeronautical experts besides those of the Wright Corp., as near perfect as is possible in this year, 1920, the work of altering, improving and amending is going ahead as steadily on the Wright engine as on the old "Hisso" from which it developed.

Selection of Air Routes and Flying Fields

By C. Le Roy Meisinger

Weather Bureau, Washington, D. C.,

There is, it seems, a vagueness in the opinions of many people regarding the value of meteorology in the selection of air routes. One reads of "pathfinding" and of "charting" flights by which it is implied that a single journey or, at most several journeys over a proposed course will afford sufficient data to designate that route as satisfactory or unsatisfactory for continued use. Such reasoning is unsound. It is obvious that the aerial medium is possessed of such a host of variable attributes, that the conditions which one finds today may not occur again in precisely the same combination for months or even years.

Of what profit shall it be to measure the temperature, humidity, and other elements, in a single flight, unless it be that these data are to be used in the discussion of the flight itself, relative to the performance of the motor or instrumental equipment, the physiological reaction of the travelers, or in one or more of the several other problems that may take the form of special tests? If such observations are to be made, they should be made over a wide area, by numerous craft, and as nearly simultaneously as possible.

The ocean of air is far from being a fixed thing. Perhaps, the likening of the atmosphere to the aqueous ocean is a figure of speech which has been somewhat overdone, and has resulted in the popular conception of aerial currents as fixed as the Gulf Stream or the Japan Current. It is also possible that the pioneer work of Rotch and Palmer, "Charts of the Atmosphere for Aeronauts and Aviators," which appeared in 1911, did not lay sufficient emphasis upon the pitfalls of too great reliance in averages.

Our atmosphere is not made up of great pemanent streams and currents, and even our conception of prevailing westerly winds aloft is sometimes shocked by the spectacle of cirrus clouds moving from the north, east, or south. Therefore, efforts to lay down definite airways without reference to the fundamental conditions which really determine desirable routes can not prevent themselves being relegated to a position of slight importance. It would be unfair to assert that any carefully made scientific observation is of no value; but it is obvious that, in such matters as the selection of air routes, other factors than such observations must be considered before one can legitimately make generalizations upon so subtle a medium as the atmosphere.

The Selection of Routes

It is self-evident that the point of departure and the destination must determine the general direction of flight. But it is by no means axiomatic that the air route shall follow a straight line between these two points. Irregularities of the terrain, its physical characteristics, and the weather along the route must, in the last analysis, determine the course of the aviator, if he is to cover the distance with the greatest economy of time and fuel. In brief, it is the geography and the climate of the region between two stations which must determine the approximate route, but the weather at the time of flight must determine the details of the aviator's course.

While the fact is recognized that a single condition may not be representative of the weather over a given route, and also that mean conditions over the same route may differ greatly from the conditions of any particular day, it is believed, nevertheless, that the best basis for laying out a preliminary route between two points lies in the mean values of certain climatological and aerological factors.

Wind.—Perhaps the most important of all the weather elements to the aviator is the wind. It is necessary in commercial aviation to take advantage of any conditions which will aid in economy of time or fuel or will be conducive to greater safety. If, then, the "pathfinder" is to live up to his name, his first concern must be to determine the speed and direction of the pervailing winds over the proposed route. These winds should be determined, not at the surface alone, but to as great altitudes in the free-air as possible. Moreover, it is very likely that he will discover that certain elevations will, in the long run, be more favorable for flying in one direction, and that other levels will be more favorable for the return journey.

Rouch and Gain have shown how important such wind studies are in regard to flying in northern Africa. The journey from Oran to Tunis, they find should be made at an altitude of about 2,000 meters, because at this elevation a strong westerly wind prevails. The return journey, in the long run, will be made most profitably at an altitude less than half as great, because the westerly wind at that elevation is greatly diminshed in force. Such prevailing winds should be determined from as long records as are available and should be worked out for small time units; seasonal averages would be valuable, but monthly means would undoubtedly be better. Not less valuable in this connection are the means of diurnal wind changes, both in speed and direction. In fact, each additional factor brings the conditions nearer to those which the aviator is likely to encounter in flight.

Digressions from the great circle path between two points would be most helpful in cases of high winds and relatively slow-moving craft. Thus, a high-powered airplane flying at 110 miles per hour in a gentle wind would gain little, if any, by departing from the great circle. But a dirigible, on the other hand, moving at 60 miles per hour might find it very much to its advantage to follow the general direction of wind flow if the speeds were quite high and if the curvature of the wind path were such as eventually to bring it near its destination. Thus, the gain to be made by departing from the great circle becomes smaller and smaller as the ratio of craft speed to wind speed becomes greater.

Cloudiness and fog.—The influence of the lower clouds and fog upon flying is very great. As a rule, it is essential to retain sight of the earth. When there are low clouds and fog, however, to keep in sight of the earth is obviously a hazardous proposition. The disadvantages of low flying when there is a cloud layer quite close to the ground have been set forth by Prof. B. Melville Jones, as follows:

1. Strain to the pilot, owing to constant bumpiness, poor visibility, and proximity to the earth.
2. Danger of collision, occasioned by poor horizontal visibility.

3. Discomfort to pilot and passengers, since flying above clouds is exhilirating.

4. Choice of altitudes is limited, and therefore it is difficult to select advantageous flying levels.

5. Annoyance to people on the ground.

6. Danger in case of forced landings.

While Prof. Jones inclines to the view that overcloud flying has advantages over undercloud flying when the clouds are low, he does not hesitate to point out the danger and discomfort occasioned by having to ascend to great heights to clear clouds; moreover, it not infrequently happens that the cloud layer is thick, or that there are several layers. The danger of flying in clouds is great, not only because of the possibility of loss of sense of balance by the pilot, but because the clouds may reach the ground without his knowledge, thus making a crash likely when attempting to land or descend to lower levels. There is also the danger of being unable to find the landing field at the end of the flight and the difficulty of navigating without visible points on the earth. Whatever may be the advantages of overcloud flying, there is no escaping the fact that low clouds are a menace to the airman.

It is therefore necessary in the laying out of proposed aerial routes to consider carefully the frequency of low clouds and fog. Bodies of water, such as lakes, rivers, and the ocean, as well as cities and deserts, often contribute to the formation of fog and the production of low visibility.

Thunderstorms.—To the pilot of heavier-than-air craft no less than to the pilot of lighter-than-air craft, the thunderstorm is a formidable enemy and one to be studiously avoided. The few who have ever penetrated the interior of a thundercloud have suffered experiences which they would not care to repeat, if, indeed, they have come through alive. Dr. Charles F. Brooks has discussed several instances in which aviators have described their experiences in or near thunderstorms.

Lighter-than-air craft are forced into the uncomfortable situation of having to land, or attempt to fly above, or around, the thundercloud, any or all of which may be extermely difficult. In the case of a dirigible balloon, it may be possible to fly around the storm as an airplane might do, and thus succeed in avoiding it. The alternative of landing in the face of the oncoming storm with its squall wind is not desirable because of the difficulty of handling the balloon on the ground. To attempt to fly over a towering thunderstorm may be entirely out of the question owing to the excessive altitude which would have to be attained, for great altitude necessitates unpleasant physiological effects and the loss of gas (through expansion) and ballast.

It is true that usually the thunderstorm is essentially a local phenomenon, which may attend the passage of the wind-shift line in a LOW or may be formed locally by strong convection. Thus, the chances of encountering thunderstorms during a given trip are very much dependent upon current general conditions. But the frequency of occurrence of thunderstorms along a given route is a thing that is vitally important to know. For one may discover that in certain months in a given region the thunderstorm frequency is so great as really to endanger the maintenance of schedules. An aircraft corporation may discover by such statistics that their craft will be placed in great danger by maintaining routes through regions of great thunderstorm frequency. The wisest course in those cases might be to modify the schedule during those times, to select new routes, or to discontinue service in that region temporarily.

Again, this knowledge can give some clue to the possibility of profitably modifying the administrative activities of the corporation, such as shifting the personnel of flying fields, distributing equipment, extra parts and supplies. All of these factors will have their reflection in direct financial returns. A blind indifference to the statistics of climate over air routes is, therefore, a narrow business policy, and that corporation which manifests this indifference is the one which, no matter how skilled its pilots, will find its dividends dwindling because of loss of equipment through accidents and consequent loss of popularity with the public.

Temperature.—The knowledge of mean temperatures over routes is perhaps the least important of the weather factors. It is true that temperature has a profound influence upon the maintenance of schedules in extreme weather. But with the improvement of aircraft engines so that they function at extremely low temperatures, and with the electrical heating of the cabins of passenger-carrying planes and dirigibles, the influence of the temperature factor is appreciably lessened.

Information regarding average vertical distribution of temperature and of the diurnal change of this distribution is helpful. Unfortunately such data are somewhat limited, but the Aerological Division of the Weather Bureau is conducting a study of a great number of kite flights which will probably supply to a large degree this need. The knowledge of mean vertical temperature distribution is not as important in the preliminary laying out of air routes as in the discussion of the current data supplied to the aviator just before he ascends.

Humidity and precipitation.—These elements are not of great importance at the outset, and they are so interwoven that their value depends chiefly upon the interpretative ability of the consulting meteorologist at the flying field.

The Selection of Flying Fields

The problem confronting the person whose duty it is to select a flying field is not an easy one; or, at least, it is one that can not be rightly solved by a mere consideration of the civil or military requirements. Today, with the multitude of flying routes being established, it sooner or later becomes the problem of the commercial clubs or chambers of commerce in most large cities to determine a landing field in the immediate vicinity. These fields have a great commercial value to the city. It is not denied that many of the local aspects, such as the availability of property, accessibility, etc., each peculiar to a given locality, rightfully have a foremost place in the consideration. But the meteorological aspect can not be neglected, for it is conceivable that, in spite of a hundred desirable features of a landing field, there may be certain characteristics which, from a meteorological standpoint, will render it utterly unfit for the purpose.

Again assuming the climatic features to be favorable, the field itself must be so laid out that it will serve most efficiently. That is to say, for instance, that the long axis of the field, if it be small and rectangular as many are, should lie in the direction of the prevailing wind at the place, because it is necessary that planes land heading into the wind and that they also rise in a headwind. The buildings should be so oriented and distributed as to interfere the least with landing or rising planes, and where the eddies and gusts they cause will not interefere with craft flying low over the field.

A very striking example of the consequences of neglecting the meteorological aspects is given by Rouch. During the war, the British desired to establish a training field for aviators for bombing instruction, and a commission was appointed for the purpose of determining the location. The shore of Loch Doon, in Ayrshire, was chosen. After the work of establishing the field was well along, the hangars were being built, a railroad was contracted for, and other expensive arrangements had been made, it was discovered that the neighboring hills gave rise to eddies and squalls which absolutely prevented safe flying at that place. The field was abandoned with a loss to the government of upwards of $2,000,000. In conclusion, Rouch says, "The installation of some instruments and the consultation of some tables of figures would have permitted 12 million francs to be saved. In that circumstance, sadly writes the *Times*. (London), the authorities did not perform their duty." It is unnecessary to emphasize the import of this example.

The Air Service recognizes the tremendous importance of the climatological considerations in the selection of flying fields. To quote from the circular which discusses this question:

> The number of flying days to be expected in a year or in any month may be fairly well determined from a study of the climatic factors. * * * It is also possible from this study to arrive at a fairly definite conclusion as to the accessibility of the field by aerial routes for different types of aircraft. In other words, one may determine the sort of aerial harbor, ease of entrance, exit, and other things considered which aircraft would find at a given field. * * * The prevaling wind and storm directions largely determine the layout of a field. The number of days to be expected when the wind speed is too high for the operation of aircraft may be closely determined. Also the number of days with excessive precipitation, with fog or storm to be expected, may be closely approximated.

The weather factors to be taken into consideration are quite the same as those which may determine aerial routes.

Precipitation comes in for greater consideration in the case of landing fields. A plane can not land or take-off readily on a muddy field, and a snow cover demands the greatest attention. As the Air Service circular points out, topography and wind are separately bound together in relation to aeronautics. The effect of wind blowing over a rough terrain is to produce rough air in which to fly. Landing fields in a hilly region are especially apt to be dangerous; and the proximity of trees and high buildings is likely to cause roughness extending to a height three or four times as great as the object. This is dangerous to a plane slowing down for a landing or for slow-flying planes.

Conclusion

An effort has been made to present the vital importance of meteorological studies in connection with the establishment of aerial routes and the layout of flying fields. The argument does not pretend to overstress the use of averages in connection with such work, but it does attempt to emphasize their importance in the preliminary work. Meteorology is the mainstay of aviation regardless of the confidence of the aviator in his motor and its ability to carry him safely over all obstacles. The dirigible has inspired us with a confidence in its future as a commercial transport; the aerial mail has definitely stamped the airplane as a reliable means of rapid transportation of mail, baggage and passengers.

Great aerial corporations are being organized. They are commercial enterprises, highly capitalized, and founded for the purpose of paying dividends to their stockholders. Dividends depend upon the skillful management of the assets of the company, the reduction of the expense of maintenance, the extension of routes into the most profitable places, the acquisition of the public confidence. Every accident is detrimental to the cause of aviation, not alone because of the direct finanical loss, but because it weakens the public confidence. The record of the Aerial Mail Service shows that the weather is responsible for the greatest number of accidents and forced landings. Many of these could be avoided by giving the weather its due consideration. Here is one of the places where the consulting meteorologist is urgently needed.—*Monthly Weather Review.*

German Commercial Flying

Rapid and intensive development of commercial flying in Germany is indicated by the report of a single German concern, the Deutsche Lufttreederei, or German Airshipping Co. which has just completed 1,000,000 kilometers (621,370 miles) of commercial air traffic in a period of not quite two years.

The German General Electric Co. is heavily interested in the enterprise, which is allied with the Hamburg-American Shipping Co. and acts as its air traffic agent. The millionth commercial kilometer has been flown recently by one of its airplanes bound from Berlin to Essen.

The Deutsche Luftreederei was organized by powerful interests in December, 1917. For one year its energies were spent exclusively in study of the problem of commercial flying and in the preparation of detailed plans for starting the business on a big scale as soon as the war ended. Actual commercial air service started at the beginning of 1919.

Available figures give an idea of the diversity and importance of the company's transportation business. Detailed mileage returns show more than 110,000 miles on the Berlin-Weimar route, on which traffic was uncommonly heavy while the old National Assembly was in session in Weimar; 96,000 miles on the Berlin-Hamburg route; nearly 100,000 miles on the Berlin-Hanover-Gelsenkirchen route. Other heavy traffic routes are Berlin-Leipzig, Berlin-Frankfurt and Berlin-Essen. Special trips totalled 160,000 miles.

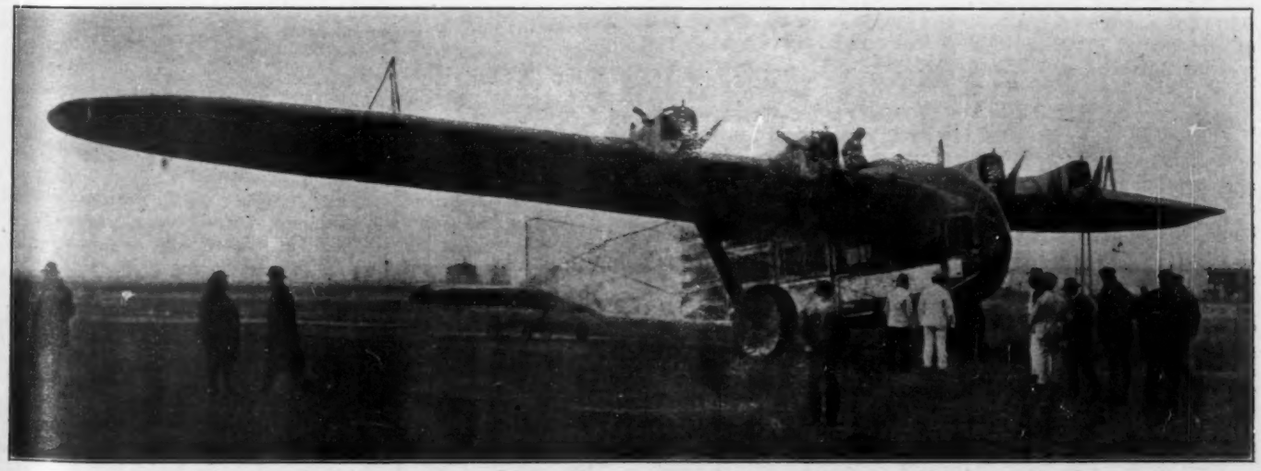
A remarkable thing about the million-kilometers performance is that it was done despite the heavy handicaps imposed on German aviation and air industry by the aerial clauses of the Versailles Treaty, and it was done under the very noses so to speak, of the Interallied Commission of Aerial Control.

Regulations Governing Parachute Jumps

A superseding order on the subject of parachute jumps has been issued by the Chief of Army Air Service, prohibiting jumps except by those who volunteer and at less than 1,500 feet, except in case of emergency. Such jumps can be made only by qualified personnel and with the approval of the commanding officer in each individual case, and in each practice jump officers or enlisted men will be required to wear two parachutes and harnesses complete, one of which must be of the free type and manually operated.

Commanding officers furnishing equipment will be held responsible for the condition and packing of parachutes and for instruction concerning adjustment of harness and suspensions prior to a flight. When parachute jumps are to be made in the vicinity of bodies of water precautions are to be taken that a life preserver or a kapok vest is worn by the jumper, and that motor boats are in readiness should a man be compelled to land in water.

The Giant Zeppelin Airplane



THREE QUARTER FRONT VIEW OF THE FOUR ENGINED ZEPPELIN-STAATEN COMMERCIAL GIANT

International

The Glenn L. Martin Commercial Transport

Aircraft, if they are to be successful commercially, can no longer be designed solely on the basis of performance as was done during the war. New standards have arisen. The efficient commercial airplane of today is judged on its commercial adaptability. Like the locomotive, the automobile and the ocean liner, the commercial features of the airplane are paramount.

With this all-important factor of commercial airplane construction predominating, the Glenn L. Martin Company of Cleveland is designing a new commercial transport which will incorporate every element of commercial adaptability. Among the principal points that are being carefully considered are the factor of safety. life of the plane, economy in operation. repair and replacement of parts, minimum work in upkeep, simplicity in housing and towing.

Fuselage

The fuselage is of general rectangular cross section, the maximum depth being 59 in. and the maximum width 50 in. outside. The fuselage is built on four spruce and ash longerons, varying from a solid section to an "X" section, in going from nose to tail. The top longerons are horizontal in flight and parallel to the axis of the engines. The lower longerons taper upward toward the upper longerons as they approach the nose and tail.

The forward section of the longerous is of ash spliced to the spruce. The longerons are solid at fitting bearing points; the nose is braced with 3/32 in., 3-ply birch plywood walls and built up plywood bulkheads to the rear of the aft cargo compartments are lined with plywood, and are braced and reinforced to carry ordinary loads. A cradle and slings are provided in the central compartment for carrying heavy concentrated loads. From this point aft, the fuselage struts are spruce and are routed out to I-beam shape. These spruce struts are stepped in cup fittings, which in turn, are brazed to the longeron fittings. The longeron fittings are of strap form, made from sheet steel, entirely circling the longeron. Each fitting, with exceptions accommodates six brace wires.

The fuselage flooring is of 3/16 in., 3-ply birch plywood, suitably braced and secured. Where spruce longeron struts are used, that is, from the pilot's cockpit back, the bracing is of solid steel tie rods. Fitted metal cowling is provided around the pilot's cockpit and metal and plywood doors are provided for the cargo compartments.

The tail skid is mounted on a swivel post and secured for shock absorption with 5/8 in. elastic cord and 3/8 in. rebound rubbers. The skid is of hickory, provided with a cast steel shoe.

All walls of the fuselage, not built with plywood, are covered with grade "A" linen, doped and finished in khaki enamel. The exterior plywood walls are also finished with khaki enamel; the interior wood parts are filled and varnished; interior metal parts are zinc plated, are covered with blue lacquer or both; the exterior metal parts are zinc plated and enameled in khaki; wearing surfaces, etc., are greased.

Wings

The wings are constructed in conventional truss form in the outer sections with front and rear spars and interplane struts and streamline wire bracing. The upper wing is made in two outer and one center section and the lower in two left and two right panels; a total of seven panels.

The interplane struts, outside of the folding wing hinge, are of routed spruce; two front and two rear on each side of the wings. Tubular steel struts, faired with aluminum are used at the folding wing hinge. The strut system around the engines, on the lower inner panels, consists of a truss work of steel tubes, faired with aluminum which connects the nacelles to the fuselage to the landing gear, and to the upper wing. The wing truss wires are of streamline wire, fitted with terminals of clevis form.

Wing panels are built on two spruce spars, routed wherever possible to I-beam sections; the front spar is 10 in. from the leading edge and the rear spar, 60 in. In the lower wing sections, an auxiliary triangle of steel tubes, inside the wings, carries the stress in the lower rear spar from the engine nacelle to the front beam at the body hinge and to the hinge fitting at the rear of the cargo compartment, in the fuselage. The ribs are of truss type, with diagonal and vertical bracing, and are built of spruce; spruce drift struts are used to carry the drag loads and spruce box ribs to close the ends of the panels.

The four ailerons are attached to the rear spars, upper and lower, at both sides of the machine. The ailerons are unbalanced and do not extend beyond the contour of the wings. The wing fittings are of plate form, made of sheet steel with attached parts braced and secured to the beams by through bolts with bearing blocks of metal. Fittings take interplane strut bolts, flying, landing, incidence and internal drag, brace wires. The internal wing wires are of solid steel fitted with adjustable terminals. The wings are covered with grade "A" linen and doped with 4 coats of acetate and two coats of nitrate dope, in the order named, the latter being impregnated with khaki wing enamel. The wood frames of the wings are wood filled and varnished.

Landing Chassis

The landing chassis is attached under the fuselage and engine nacelle and consists of two 44 in. x 10 in. wheels and two nickel steel tubular axles. The axles are held in place laterally by the medium of sway braces attached under the fuselage and support the machine by means of A-struts. These struts are vertical; two being attached under each nacelle. The landing gear A-struts are of nickel steel tubing and are braced from the rear.

Each wheel is shock absorbed with 5/8 in. elastic cord and the shock absorber is enclosed in a streamline covering; mud guards are provided for each wheel. The landing gear A-struts are streamlined with wood and covered, where necessary, with grade "A" linen, doped and finished in khaki enamel. The sway braces are streamlined with aluminum and magnesium fairing and are provided with steps to facilitate work upon the engines when they are not running.

Tail Surfaces

The tail surfaces consist of elevator, stabilizer, two rudders and two vertical fins, all built upon the stabilizer. The elevator is hinged to the trailing edge of the stabilizer and the rudders and fins are mounted on top of it. The entire unit is mounted on top of the fuselage tail and braced with steel tubing and steel tie rods or cables.

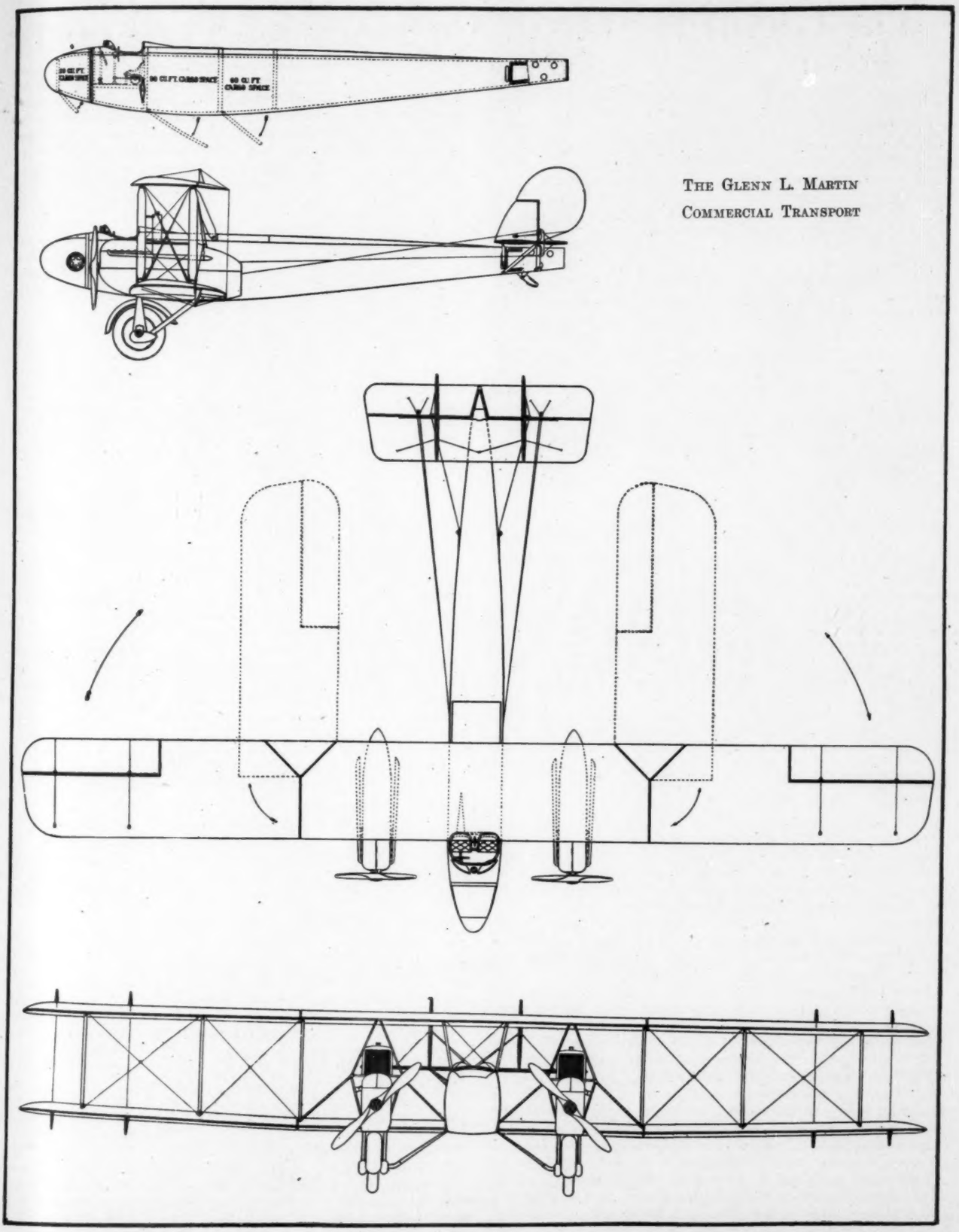
The tail surface unit may be detached intact. The stabilizer is adjustable from 0 deg. to minus 4 deg. from the pilot's cockpit, during flight. All tail surface frames are of steel tubing and are channel section. The frames are enameled and covered with grade "A" linen. The covering is doped and finished with khaki wing enamel.

Power Plant

Each engine is mounted in the forward portion of its nacelle. The engine bed is built in the top of a vertical plywood bulkhead, braced laterally by a horizontal plywood bulkhead, connecting it to the nacelle longerons. A sloping bulkhead connects the forward end of the engine bearers to the front spar of the wing. The oil tanks are carried beneath the engines.

The batteries are carried beside the starters at the rear end of the engines. Directly behind the rear end of the starters is an aluminum covered plywood fire wall, which runs from the top to the bottom of the nacelle. On top of the fire wall and outside of the nacelle is the radiator.

Behind the fire wall and sparated from it by an air space, is the gasoline tank. The gasoline tank ends at the rear spar where there is another vertical bulkhead. Behind this bulkhead is a fairing to streamline the nacelle. A removable cover



THE GLENN L. MARTIN COMMERCIAL TRANSPORT

is provided for this, making it available for the storage of tools, etc. Detachable cowling is also provided over the engines. All cowling on the nacelles is sheet aluminum.

The engine controls are carried to the fuselage through the wings, being run over pulleys at the nacelles and at the inner end of the wings and being run through straight aluminum tubes between these points. All controls are standard cable. A gravity tank is provided in the upper wing over each engine, and a sight glass in the overflow line enables the pilot to determine at all times, whether gasoline is being pumped to the gravity tank. The entire gasoline system is designed to withstand a pressure of 5 lb. per sq. in.

Specifications

GENERAL DIMENSIONS

Span, overall, both wings	74	ft.	2	in.
Length, overall	43	ft.	7-5/16	in.
Height, overall	15	ft.	6- 3/4	in.
Chord			95	in.
Aspect Ratio	9.36			
Gap			102	in.
Gap to chord Ratio	1.085			
*Dihedral angle	180	deg.		
Angle of wing setting to propeller axis	2	deg.		
Sweepback, stagger, washout	None			
Propeller clearance from ground, horizontal			20	in.

*176 deg. from folding hinge out in lower wing

AREAS (Wings and Control)

	Albatros	
Wing curve		
Upper wing area, including ailerons	577	sq. ft.
Lower wing area, including ailerons	544	sq. ft.
Total wing area, including ailerons	1121	sq. ft.
Ailerons, 4, each 32.5 sq. ft. total	130	sq. ft.
Elevator area	43	sq. ft.
Stabilizer area	62.25	sq. ft.
Rudders, 2, each 19.75 ft., total	39.5	sq. ft.
Fins, 2, each 9 sq. ft., total	18	sq. ft.

WEIGHTS

Total weight of machine, fully loaded	12,000	lb.
Weight of machine, empty	6,840	lb.
Total useful load	5,160	lb.
Crew (pilot and mechanician)	360	lb.
Cargo capacity	3,000	lb.
Weight carried per sq. ft. of supporting surface	10.7	lb.
Weight per brake hp.	15.0	lb.

POWER PLANT

2 Liberty 12 cylinder "V" type engines.
2 two-blade, 10 ft. diameter tractor propellers.
2 main gasoline tanks ,total capacity 280 gal., located in the engine nacelles.
2 gravity feed gasoline tanks, total capacity 20 gal.
2 radiators, honeycomb type, mounted in rear of engines, on top of nacelles.
2 gear-driven gasoline pumps, connected with engines.
2 oil tanks; total capacity 22 gal., mounted one beneath each engine in the nacelles.
2 Bijur rear end starters with batteries and equipmnt, mounted one in each engine nacelle.
A water thermometer, an oil pressure gauge and a gasoline level gauge are mounted on each engine nacelle, in clear view from the pilot's cockpit.

PERFORMANCE

Speed, maximum, horizontal flight	110 m. p. h.
Speed, economical	100 m. p. h.
Speed, minimum landing	52 m. p. h.
Climb from sea level in 10 min., fully loaded	5,000 ft.
Radius of operation, fully loaded under full power	4 hrs. 30 min.
Radius of operation, at cruising speed	600 miles
Ceiling	13,000 ft.

EQUIPMENT

This includes a complete set of instruments: Air speed indicator, alimeter compass, clock, inclinometer, lateral indicator, tachometers, gasoline level gages, oil pressure gages, compass, oil temperature thermometers, water temperature thermometers, self starters, navigation lights, instrument lights, trouble lamps, fire extinguishers, ammeter, all necessary switches, wiring, etc., safety belts, life preserver seat cushions and Thermos bottles.

Air Movies of Yosemite Park

Perhaps one of the most constructive efforts put forth to popularize flying on the Pacific Coast was the flight made by Dan Davison accompanied by Stanford Greenwald, Fox News camera man, into Yosemite Park. The trip was made in Earle Cooper's Curtiss Standard plane equipped with a Liberty six motor. The first pictures of the great park, taken from the air, were made by Greenwald.

In order to successfully enter the valley, an altitude of eleven thousand feet had to be maintained until directly over the landing field. Then followed the descent to the floor of the valley which had to be negotiated with extreme care due to the great height of the cliffs surrounding the landing field.

The following day two flights were made, one with a passenger. The other was made for the purpose of taking movies of important points of interest. The pictures show how close the plane came to the cliffs and when the falls were taken, the range was so short that both pilot and camera man felt the spray.

Before leaving the valley, Greenwald conceived the idea of taking some pictures of stunts with the cliffs as a background. This was done and the effect was most surprising. Ordinarily plane stunt pictures are very unsatisfactory as there is no sense of horizon and the plane seems to do meaningless flitting from top to bottom of the screen. It is impossible to understand just what the plane is supposed to be doing.

In the Yosemite pictures however, every move is distinct. If it is a barrell roll or an Immelmann, one cannot mistake it.

Apparatus for Making and Handling Hydrogen

The Experimental Station at Fort Omaha is conducting experiments in apparatus for the handling and manufacture of hydrogen gas for balloons. This work is of importance because, with the coming of large dirigibles and the general expansion of the lighter-than-air branch of the service great quantities of this gas at a reasonable price are necessary. Proper equipment for handling the gas insures safety and economy in its use.

The gas used in balloons is frequently stored in cylinders under the high pressure of 2000 lb. per sq. in. Under this high pressure it is difficult to get valves to work smoothly and easily and still be tight in service, preventing gas losses from leakage. At this experimental station, such valves have recently been designed. Like other good pieces of mechanism, they are comparatively simple in design, and they can be made much more cheaply than the more complicated valves previously in use. In addition they have been especially designed to meet Air Service demands which require a valve that will vent a cylinder rapidly without freezing up. The standard valve now in use requires seven minutes to completely vent a cylinder, while the present valve developed at Fort Omaha will accomplish this in from twenty-five to fifty seconds.

Fort Omaha is being equipped with a machine shop which will be suitable for the manufacture on the working scale of much of the machinery being designed there. One of the first pieces of apparatus which will be manufactured in this shop is a hydrogen gas generator known as a silicol generator because of the fact that, in its operation, the hydrogen is produced by mixing ferro-silicon and caustic soda. In this generator are embodied the results of wide experience gained in operation of this type of equipment during the war.

Such improvements have been made that the new generator will produce almost twice as much hydrogen from a given quantity of materials as did the older types. At the same time, a generator of a given size will almost double the capacity of former machines.

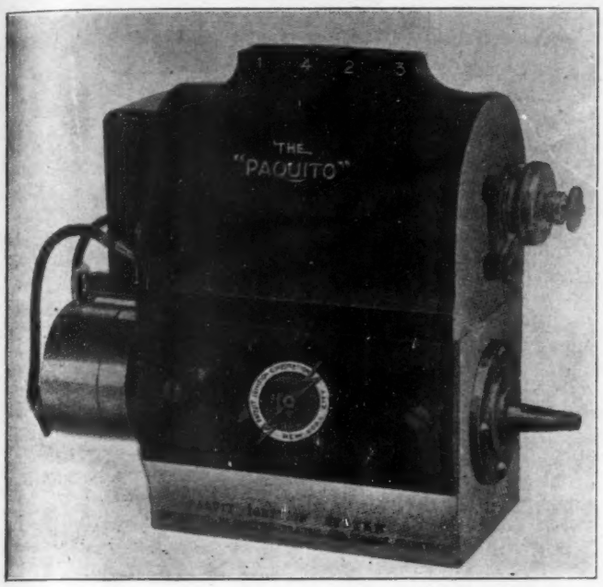
Furthermore, there is ready for test an improved type of electrolytic cell for the production of hydrogen gas. The design of apparatus of this kind requires highly developed technical skill. This particular apparatus, like the silicol generators already developed, is expected to produce many times more gas for a unit of given size than does apparatus of the same type now in use. In present apparatus, a good deal of trouble is experienced with insulation; in the newer design, this will probably be avoided altogether, or at least greatly reduced. The decomposition of water by the electric current is a long established process but, like most similar processes, is susceptible of a good deal of development in the hands of trained engineers. It is an indication of the general progressiveness of the Omaha station, and the Air Service in general, that technical problems of this kind are being undertaken and that the highest development and the greatest efficiency are the things constantly sought after.

Compass on Tail of Plane

A new aeronautical compass, called a distant type has been developed. It is mounted at the tail of an airplane, and is thus removed from the disturbing magnetic influences set up by the iron of the engine and the inductive effect of magnetos and coils. It depends for its action upon the peculiarity of the element selenium to vary in electrical conductivity with the volume or intensity of light falling upon it. In the new compass the indicator card is perforated with two specially shaped slots which allow beams of light from two bulbs in the compass bowl to play upon two selenium cells mounted on a bridge across the top of the instrument. As the intensity and volume of the light beams vary with the position of the slots in the indicator card, a current constantly flowing through the selenium is altered in value. The current fluctuations are indicated by a specially calibrated ammeter mounted on the instrument board directly in front of the pilot. The indications are interpreted in terms of changes of direction. When both navigator and pilot are carried, the former may change the direction of flight without the necessity of communicating his orders to the latter, by turning the whole compass bowl.

The Paquito Ignition System

A new ignition system which gives promise of extensive use in aeronautical work is the "Paquito". It is a very simple and compact battery system, and is claimed to be an improvement over other systems because of its durability, its slower



THE PAQUITO IGNITION UNIT

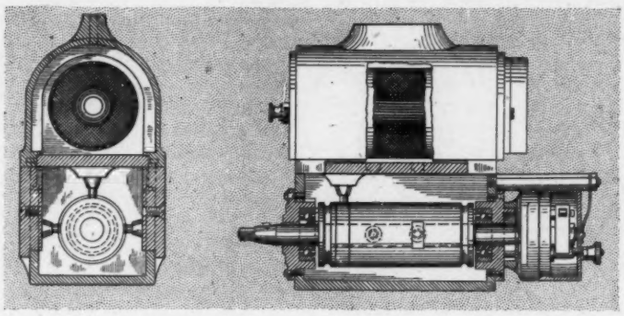
speed, lightness and its ability to give greater power to the engine.

It is the invention of Vital Paquit, a Belgian automobile and electrical engineer and has been developed to a high state of efficiency by D. Bruce Morgan, a mechanical and electrical engineer of international reputation. In it are combined all the esentials of a battery and coil ignition grouped in a very efficient and neat maner.

The Paquito unit is made up of two sections; the upper or "coil section" and the lower or "distribution section." The upper presents few new departures from the conventional coil group, although the manner in which the details have been worked out will be found to be particularly clean cut and elementarily efficient.

The distribution in the lower half is novel and it is in this portion of the instrument that the ingenuity of the engineers is shown. The rotor is enclosed in the lower half and consists of a knurled steel shaft on which is moulded a condensite drum carrying a brass distribution ring and the two or more distribution segments. The drum is improvement over the usual method as it is simpler and more excessable. It is also less likely to get out of order due to its solid construction.

The upper compartment contains the coil with a condenser of



SECTIONAL VIEWS OF THE PAQUITO IGNITION UNIT

conventional type with mica separators. It is located at one end of the coil, outside of the coil compartment.

The breaker is mounted on the rotor shaft outside of the case proper and is similar to the type used on a magneto. A cam located on the end of the rotor shaft operates the breaker points, the number of lobes on the cam corresponding to the number of cylinders. The breaker arm carries a cam follower of micarta which is self-lubricating and practically wearproof.

The extreme point of coil saturation occurs at 5,000 r.p.m. To reach this point the device running ½ to 1 would require an engine speed of 10,000 r.p.m. Such speeds are not possible with any type of internal combustion engine of present-day design.

The small details are carefully worked out and possess the great advantage of being simple and well made. The chief advantage claimed for this system over any other now on the market is the fact that the rotor runs at half engine speed instead of engine speed. This allows the coil to build up and reach the extreme point of saturation before breaking the circuit thereby giving a flaming spark at all engine speeds.

The Italian "6-Meter" Competition

The table given herewith gives the data concerning the contest held by the Aerial League of Italy to promote the development of small machines for sporting uses. Three types were entered and the results indicate that these machines have a very good performance for their size and power. One of the principal conditions of this competition was that the span of the planes should be less than 6 meters (19.68 ft.) The data follows:

	SPECIFICATIONS							RESULTS								
Firm and Pilot	Span ft.	Machine Length ft.	Height ft.	Make	Engine No. of Cyl.	Bore in.	Stroke in	Make	Propeller Diam. ft.	Consumption oz./mi.	Take-off ft.	Take-off sec.	Land'g ft.	Speed m.p.h.	Ceiling ft.	Glide from 3280 ft. min.	Glide from 3280 ft. sec.
Breda Pensuti No. 2																	
L. Montegani	13.25	14.98	9.52	Anzani	6	3.54	4.73	Breda	6.30	5.8	164	8.4	152	72.1	8,200	2	56.8
Macchi 16 No. 1																	
De Briganti	19.53	14.83	6.83	Anzani	3	4.14	4.73	Macchi	6.23	2.2	164	9.2	187	86.4	12,700	8	11.4
Ricci																	
Albertazzi	11.65	12.48	7.48	Anzani	6	3.54	4.73	Ricci	6.40	5.0	185	6.0	209	79.8	4,920	2	23.2
Breda Pensuti No. 1																	
L. Montegani	13.25	14.78	9.52	Anzani	6	3.54	4.73	Breda	6.30		214	7.2	154.5				
Macchi 16 No. 2 ..	19.53	14.83	6.83	ABC Gnat	2	4.33	4.73	Macchi	5.91	4.55	234	7.4					

Receiver Appointed for L. W. F.

The L. W. F. Engineering Co., College Point, Long Island, N. Y., the largest aircraft manufacturing plant in the United States, went into the hands of a receiver on December 3. The receivership, according to a statement authorized by Ernest Whitbeck, the receiver, is the result of the failure of the government to recognize its responsibility to the aircraft industry by permitting the dumping of foreign surplus equipment, by delaying enactment of an aerial code which would have accelerated commercial aeronautics, and by its inability to place orders for new equipment for the national defense which the Air Service needs.

The L. W. F. company was one of the pioneers in the aircraft business. It was capitalized at $1,000,000 and had employed during the War more than 2,000 people. The following statement was authorized by Ernest Whitbeck, the receiver:

"The L. W. F. Engineering Co., of College Point, Long Island, was placed in the hands of a receiver today. By a remarkable coincidence, in the annual report of the Chief of Air Service today, Maj. Gen. Charles T. Menoher also states that, 'Unless the Government aids the airplane industry, it cannot hope to depend upon the availability of suitable commercial aircraft and facilities for their employment nor upon the existence of manufacturing plants and supplies of materials necessary for the rapid production of aircraft in time of war.'

"The receivership of the L. W. F. company is the result of the failure by the Government to evolve and put into operation a definite aeronautical policy or programme. The L. W. F. company was one of the pioneers. At the time of the receivership it had the largest aircraft manufacturing plant in the United States. It was capitalized at $1,000,000 and had employed more than 2,200 people at the time of the Armistice.

"The L. W. F. company was organized in 1915. It was the originator in this country of the laminated wood fuselage, now largely used in aircraft construction. It built the plane which was the first to fly the Liberty engine.

"Since the armistice the L. W. F. company has endeavored against heart-breaking odds to bridge over the period between military production and peace-time development. The Government has so far neglected to recognize its responsibility in the utilization of aircraft in national defense as to fail, in the two years since the armistice, to formulate or put into operation a policy by failing to prevent the dumping of foreign surplus equipment, by failing to enact an aerial code which would have facilitated commercial business or by permitting orders to be placed for equipment which General Menoher states the Air Service is sorely in need.

"The L. W. F. Company covers five city blocks. The company has its own water and land terminals. At great expense the company developed and built the "Giant," America's largest airplane, and one of the largest ever constructed, which a few weeks ago was accepted by the Air Service as a coast defense bomber."

The L. W. F. company's recent statement shows assets in excess of $1,300,000 after very liberal charges for depreciation and total liabilities of about $525,000. The receivers were appointed upon the written consents and requests of creditors representing about seventy per cent of the total liabilities. It is planned to continue the business to a limited extent until the aircraft business warrants conservative expansion. At that time the company hopes that it will be able to secure sufficient additional capital to resume business independent of the receivership.

Airport to Be Purchased in Oregon

The deal for purchase of land for a municipal aviation field will be closed at once, according to announcement of Mayor Peterson at a meeting of the city council of Eugene, Ore. recently. It was announced that all but four owners of small tracts included in the land to be purchased, have agreed to sell.

The people at a special election last May voted bonds for the purchase of this tract. Owing to a poor market for municipal bonds at the present time the council was unable to sell them to regular buyers, but most of the owners of the tract agreed to take the bonds in payment.

New Ignition Introduced to Engineers

Prominent men of the automotive industry gathered at the Automobile Club, New York, on the evening of November 23, to dine as the guests of E. H. Morrice, managing director of the Paquit Ignition Corp. of New York, and learn of a new development in ignition of internal combustion engines, the "Paquito," an improved coil and battery system.

Besides an excellent dinner, entertainment was furnished by vaudeville artists. The speakers covered the trend of development of transportation with emphasis on the flexibility of automobile and airplane transportation. The part that aircraft are beginning to play in transporting mails, goods and passengers in this country and abroad was discussed.

Brig.-Gen. William Mitchell, Assistant Chief of the United States Army Air Service, emphasized the supreme importance of an adequate air service as demonstrated by the development of air tactics and air forces during the war. This development has today reached the point, General Mitchell stated, where control of the air means control of the water.

During the latter year of the war the air services were not only fighting each other for supremacy of the air but they were fighting the armies on the ground and were beginning to fight the navies on the water. In her post war development of aviation Great Britain has recognized the fact that sea communications are at the mercy of superior air forces and is shaping her policy accordingly.

Gen. Mitchell also clearly explained the relation of commercial aviation as a reserve for military aviation for national defense. The mechanical means for successful commercial aviation are here today, he pointed out, the great essential now being adequate ground organization and frequent landing fields.

Recent development of commercial air transportation in Europe was covered in a talk by Alexander Klemin, technical editor of AVIATION based upon his personal investigation of conditions in European countries during the past two months. Mr. Klemin pointed out that his study of foreign conditions has shown that the products of American airplane designers and engineers are on a parity with their foreign contemporaries, with the exception of all-metal construction which in Germany has been made the subject of special study and development for several years. The performance of American designed and constructed planes and engines in the Pulitzer Trophy race a few days later amply confirmed the speaker's ideas on this subject.

Vital Paquit the inventor of Paquito ignition was introduced to the diners, and D. Bruce Morgan, an engineer who played an important part in the development and perfection of the Paquito explained the technical advantages of the new ignition which are described elsewhere in this issue. Recent severe road tests have shown, it is claimed, that the Paquito combines the advantages of battery and coil system for low speeds with all magneto advantages for high.

An actual demonstration was given of the operation of a four cylinder Paquito with spark plugs attached, and Mr. Morgan replied to the technical questions asked by those interested.

David Beecroft acted as toastmaster. Prominent guests included Glenn H. Curtiss, Brig.-Gen. William Mitchell, Fay L. Faurote, W. E. Bullock, Frank Crane, Dr. W. E. Deeks, F. S. Duesenberg, Chas. M. Manly, F. H. Trego and Alexander Klemin.

Aviation Pioneer Dies

James Means, a pioneer in aviation, whose writings were a part of the reading that inspired the Wright brothers, died at his home in Boston on December 3. His ideas and visions of the possibilities of aviation were set out in the "Aeronautical Annual" which he founded and published for several years in the nineties.

It was in the Annual that the Wrights found their inspiration, according to a speech by Orville Wright at the Engineers' Club in Boston four years ago, when he paid high tribute to the services to aviation of Mr. Means. In business Mr. Means was a manufacturer of shoes. He retired in 1892 and thereafter gave much of his time and attention to flying.

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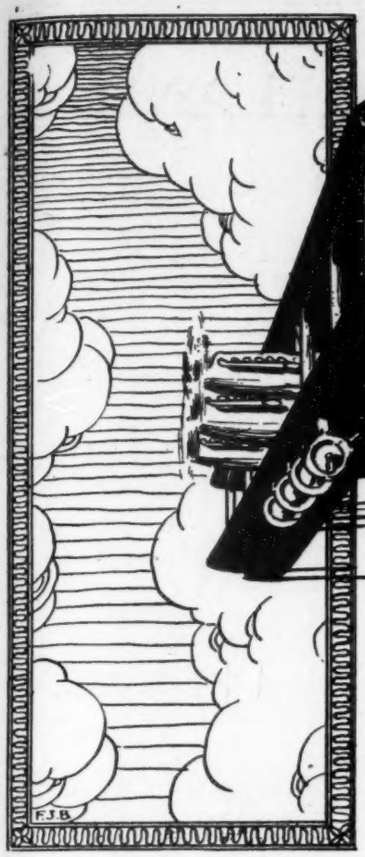

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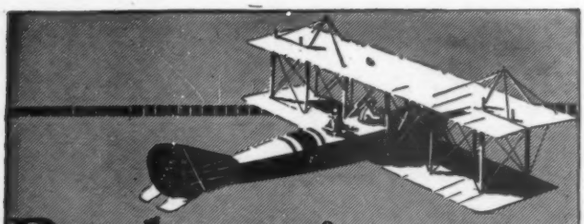

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